NORTHEAST FLOOD STUDIES

REPORT

ON

REVIEW OF SURVEY

FOR

FLOOD CONTROL AND ALLIED PURPOSES

NORWALK RIVER BASIN

CONNECTICUT AND NEW YORK

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

15, MARCH 1967

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SYLLABUS

The Division Engineer finds that the Norwalk River, a coastal stream in southwestern Connecticut, has caused major flood damages in the city of Norwalk and the town of Wilton. He further finds that reductions in flooding to be effected by an approved watershed work plan of the Soil Conservation Service of the Department of Agriculture would be realized chiefly in the upper part of the basin, leaving downstream areas still susceptible to damage from flooding. He concludes that additional measures for flood control are needed and justified in the basin.

The Division Engineer recommends authorization of local protection works consisting of channel improvement and construction of dikes and flood walls along 10,000 feet of the Norwalk River in Norwalk and Wilton. He recommends further that, prior to construction, local interests be required to give assurances that they will: (1) provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project; (2) hold and save the United States free from damages due to the construction works; (3) maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army; (4) provide, without cost to the United States, all relocations of buildings, utilities,

highway bridges, sewers, and related and special facilities; and (5) prevent encroachment on the improved channel.

The first cost of the project is estimated at $4,300,000, of which $2,700,000 is the Federal cost and $1,600,000 the non-Federal cost. Annual costs for maintenance of the project, an item of local responsibility, are estimated at $4,000.

REPORT ON REVIEW OF SURVEY FOR FLOOD CONTROL AND ALLIED PURPOSES

NORWALK RIVER BASIN CONNECTICUT AND NEW YORK

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO:
NEDED-R

15 March 1967

SUBJECT: Report on Review of Survey for Flood Control and Allied Purposes, Norwalk River Basin, Connecticut and New York

TO: Chief of Engineers
ATTN: ENGCW-PD

AUTHORITY

1. This report is submitted pursuant to authority contained in a resolution of the Committee on Public Works of the United States Senate, adopted 14 September 1955, which reads in part as follows:

> "That the Board of Engineers for Rivers and Harbors ... be, and is hereby, requested to review previous reports on ... (major rivers in northeastern United States)...and intervening streams; in the area affected by the hurricane flood of August 1955, to determine the need for modification of the recommendations in such previous reports and the advisability of adopting further improvements for flood control and allied purposes in view of the heavy damages and loss of life caused by such floods."

EXTENT OF INVESTIGATION

2. SUMMARY OF STUDIES

This report, in full response to the authorizing resolution insofar as it pertains to the Norwalk River, presents the results of studies to determine the desirability of further flood control measures in the Norwalk River Basin, Connecticut and New York. In view of the authorization of a plan developed by the Soil Conservation Service, U. S. Department of Agriculture, for reservoirs and channel improvement projects in the basin above the site of the proposed new Route 7 river crossing in Wilton, this report is principally concerned with the basin flood problems below this proposed crossing. The report presents a recommended local protection plan for Norwalk and Wilton consisting of channel improvement with dikes and flood walls.

Office studies have consisted of hydrologic and hydraulic analyses; estimates of the quantities and costs of major work items entailed in construction of the recommended project and several considered alternates and economic analyses. Field work has included determination of flood damages and subsurface investigations to determine the nature and characteristics of underlying material. Recent aerial photogrammetric maps, at a scale of 1:2,400 with five-foot contour intervals, furnished by the State, were used in the study. Field reconnaissance of the problem area has been made by the Division Engineer and representatives of his office.

3. COORDINATION

Representatives of the Division Engineer have met with Federal, State and local officials to present and discuss Corps' plans for flood control in the basin. Coordination with other agencies is described in paragraph 42.

A public hearing (see paragraph 28) was held in Wilton on 26 May 1966 to acquaint all interested parties with the plans of protection under study and to secure their views and comments thereon. The views of local interests were considered in arriving at the recommended plan of protection.

4. PRIOR REPORTS

Flood control and allied water uses in the Norwalk River Basin were considered in Part Two, Chapters XXIII and XXIV (unpublished), titled "Connecticut Coastal Area" and "Special Subjects, Subregion 'B'," respectively, of the report "The Resources of the New England-New York Region" prepared by the New England-New York Inter-Agency Committee pursuant to Presidential directive 9 October 1950. Part One and Chapter I of Part Two have been printed as Senate Document 14, 85th Congress, 1st Session. This comprehensive report presented an inventory of the resources of the New England-New York area and recommended a master plan to be used as a guide for the regional planning, development, conservation, and use of land, water and related resources of the region. The report found that flooding had not been a serious problem in the Connecticut coastal area. However, this report was prepared prior to the great floods experienced in August and October 1955.

BASIN DESCRIPTION

5. LOCATION AND EXTENT OF BASIN

The Norwalk River Basin is located approximately 45 miles northeast of New York City and 12 miles west of Bridgeport, Connecticut. The greater part of the basin is in Fairfield County, in southwestern Connecticut, with a small portion being located in Westchester County, in southeastern New York. The basin extends about 14 miles in a southerly direction from its headwaters to the head of tide on the Norwalk River in Norwalk. It has a maximum width of about six miles and an area of 58 square miles. Located in the basin are portions of the city of Norwalk and the towns of New Canaan, Redding, Ridgefield, Weston, and Wilton, all in Connecticut, and the town of Lewisboro, New York. Plate 1 shows a map of the basin and its proximity to New York City and the Connecticut metropolitan areas of Bridgeport, New Haven and Hartford.

6. CLIMATOLOGY

The climate of the Norwalk River Basin is variable but moderate by comparison with the extremes of cold and snowfall experienced in the higher elevations of interior New England. The average annual temperature at Norwalk, computed from 59 years of record, is about 50°F. Extremes in temperatures range from occasional highs of over 100°F. to lows of -20°F. Basin temperatures inland will average somewhat lower than those at Norwalk.

The average annual precipitation over the basin is about 48 inches. Annual snowfall averages 34 inches with snow occurring between November and April.

7. STREAMS

The Norwalk River is formed by a small stream that flows northerly into Great Swamp and Taylors Pond in the town of Ridgefield, Connecticut. From its source, the river flows easterly about $1\frac{1}{2}$ miles, then in a general southerly direction, through the towns of Ridgefield, Redding, and Wilton to the head of tidewater in the city of Norwalk, a total distance of about 20 miles. The lower $1\frac{1}{2}$ miles of the river is tidal and constitutes Norwalk Harbor on Long Island Sound. The main river has a drainage area of about 35 square miles above tidewater and a fall of approximately 560 feet.

The only major tributary of the Norwalk River is the Silvermine River. This tributary starts at Browns Reservoir in the town of Lewisboro, New York, although its headwater tributaries rise about three miles north of the reservoir in Ridgefield, Connecticut. This river flows in a southeasterly direction about 10 miles to join the Norwalk River at the Broad Street bridge in Norwalk. It has a drainage area of about 23 square miles and a fall of 390 feet.

8. TOPOGRAPHY

Except for its narrow shore zone, the basin is generally hilly with scattered areas of moderate to steep slopes. The maximum elevation of 860 feet above mean sea level is reached in Ridgefield in the northern part of the basin. While the upper portions of the basin are chiefly residential or rural, with a large percent being in second growth woodland, the Norwalk-Wilton area in the south has extensive urban developments.

9. GEOLOGY AND SOILS

The Norwalk River drains the southern coastal section of the western Connecticut Highlands adjacent to Long Island Sound. This is an area of steep-sided, rock-controlled valley slopes, thinly mantled by glacial till, abutting broad valleys filled with thick deposits of glacial lake materials. These latter deposits, which typically consist of bony sand and gravel, have an estimated thickness in excess of 30 feet and are overlain in much of the area by variable depths of silty sands containing boulders in scattered local surface concentrations. Land fills of industrial and small business developments encroach on large portions of the Norwalk River flood plain. These fills include rock blocks removed during land development adjacent to the valley walls. The bedrock consists of crystalline rocks of Paleozoic Age and are predominantly comprised of schists and gneisses which have been extensively intruded by granitic bodies.

10. AREA MAPS

The Norwalk River and its watershed are shown on standard quadrangle sheets of the U. S. Geological Survey at a scale of 1:24,000 and on quadrangles of the U. S. Army Map Service maps at scale of 1:25,000.

ECONOMIC DEVELOPMENT

11. POPULATION

The greater part of the basin population is found in Redding, Ridgefield, Wilton, and Norwalk, Connecticut, the last being the fourth largest city in the Connecticut coastal area. The population has increased in Norwalk and all the basin towns during the decade of 1950-1960, nearly doubling in Wilton and Ridgefield as indicated in the following tabulation of U.S. Census figures.

City or Town	Population	
	1950	1960
Norwalk	49,460	67,775
Ridgefield	4,356	8,165
Wilton	4,558	8,026
Redding	2,037	3,359

Local estimates of 1965 populations in the basin communities indicate a continuation of the high rate of population growth.

12. INDUSTRY

Manufacturing is of prime importance to the economy of the basin. It is concentrated chiefly in Norwalk which, even during Revolutionary times, was a center for the production of clocks, watches, shingle nails, paper, and hats. Among the principal items of manufacture in Norwalk at the present time are air conditioning equipment, air compressors, boilers and tanks, data processing equipment, electrical equipment, furniture, machine tools, optical and space control instruments, plastics, pumps, clothes, woven labels, tires, tubes, valves and toys.

In the three towns along the main river above Norwalk, industrial activities include: electronic and chemical research and the manufacture of golf clubs and wooden specialties at Wilton; the production of woven mesh wire at Redding; and the manufacture of valves and rubber toys in Ridgefield. Electronic development and research facilities are also centered in Ridgefield.

13. AGRICULTURE

High standards of residential zoning regulations and the demand for land for residential and commercial uses in the basin - as in most of Fairfield County due to its proximity to New York City - make the value of agricultural land high. The average price of agricultural land in the county is over three times the average for the entire state. Most of the undeveloped land is forested and much of this is held by residents in the rural areas, a few large estate owners, and the water commissions of the city of Norwalk. Considerable acreage is in orchards and crops. Fruit growing and nursery cultivation are the chief agricultural activities in the basin.

14. TRANSPORTATION

The basin is served by a network of modern highways. Traversing the basin in a general north-south direction are U.S. Route 7 and State Route 33; and in a general east-west direction are the Connecticut Turnpike (Interstate 95), U.S. Route 1, the Merritt Parkway (State Route 15), and State Route 102. Rail transportation, both freight and passenger, is provided by the New Haven Railroad. Regularly scheduled airline service is available at the Bridgeport Municipal Airport about 15 miles east of Norwalk. Small airports are located in nearby communities in Connecticut and New York.

The harbor at Norwalk is used by a number of pleasure boats and the City maintains a boat dock at Rowayton. The existing Federal navigation project in Norwalk Harbor is described in paragraph 25 of this report.

15. TRENDS OF DEVELOPMENT

The Norwalk River Basin is located in one of the most prosperous counties in the United States. Lying about 45 miles from New York City, the lower part of the basin is actually an extension of the vast urbanized area which surrounds that Metropolis. Modern highways and the main line of the New Haven Railroad have fostered the growth of numerous bedroom communities in the basin for business and professional people employed in New York.

Side by side with these developments, and in many cases in the same communities, there is a booming local economy based on a diversified mix of manufacturing plants, research laboratories, and trade and service industries.

The economy supports a population which in the past two decades has grown at a rate consistently higher than that for the state as a whole. This growth in population is projected to continue. Fairfield County in Connecticut and neighboring Westchester County in New York have the advantages, inherent in a suburban location, of better housing opportunities for personnel and an attractive plant environment, both important to industry in terms of personnel morale. In the past decade, these two counties have attracted industry to establish research and development facilities within their towns. Industrial facilities of this nature are encouraged by the communities since generally the costs for community services generated by the plant tend to be less than the increase in tax revenue which the plant provides. Four such facilities have been built in the Norwalk River flood plain below Wilton center in the recent past. The demand for land suitable for building makes it certain that the flood plain of the Norwalk River below the center of Wilton will be completely built over by 1970. The extremely high demand for land makes it improbable that restrictive zoning would be used in this area.

BASIN PROBLEMS

16. FLOOD CONTROL

The Norwalk River is susceptible to floods caused by heavy rains and, at times, rainfall aggravated by snowmelt. This flooding causes inundation of, and resulting damage to, properties along the banks of the river, particularly those of industrial and commercial interests located along the two-mile reach above Grist Mill Road in Norwalk. Highway and rail traffic are also greatly inconvenienced at such times.

Since much of the flood plain in the basin is already highly developed, zoning would at best be a partial and, for the small remaining undeveloped acreage, not an immediately effective solution. Under existing legislation, the Water Resources Commission of the State has established river encroachment lines along the Norwalk River in Wilton.

The Soil Conservation Service's watershed work plan for the upstream portion of the basin, described in paragraph 26, would effect some reduction in flood flows in the downstream area, below the center of Wilton, but would not eliminate the threat of damaging floods.

The problem, in general, resolves itself into one of securing a plan of improvement that will afford needed additional protection, economically justified by resulting benefits, for as great a part of the flood-prone areas of the basin as possible.

17. WATER SUPPLY

The city of Norwalk maintains water supply reservoirs in the watershed and contemplates further developments for this purpose. While additional sources of water for domestic and industrial use will be needed in the basin, no current development for water supply in combination with flood control purposes appears economically feasible at this time in any of the projects studied for this report.

18. POWER DEVELOPMENT

The development of hydroelectric power in conjunction with flood control was determined to be not economically feasible at any of the considered reservoir sites.

FLOOD HISTORY

19. Prior to 1930, the history of floods in the basin is very sketchy. Available accounts do indicate that floods have occurred at all seasons of the year. Major basin-wide flooding has been infrequent. Minor damages have been experienced repeatedly from the flooding of developments at isolated locations in the flood plain. Floods have generally resulted from intense rainfall alone, but runoff from snowmelt has contributed occasionally to high flows in the river. Major floods occurred in September 1938, March 1953 and August and October 1955. The last flood, the maximum of record, had an estimated peak discharge of 8,300 cubic feet per second in the South Wilton area. Except in the lower tidal reach, below Wall Street in Norwalk, abnormally high tides do not affect the level of flooding in the Norwalk River.

STANDARD PROJECT FLOOD

20. A standard project flood is a synthetic flood used by the Corps of Engineers to measure the flood potentialities of a river basin. It represents flood discharges which may be expected from a combination of severe meteorological and hydrological conditions that are considered reasonably characteristic of the geographical region involved, excluding extremely rare combinations. The standard project flood is used as a criterion for establishing design grades for walls and dikes in local protection projects, for determining the desirable design capacity of channel improvement projects, and for checking the effectiveness of flood control reservoirs.

The standard project flood for the Norwalk River, unmodified by the watershed work plan of the Soil Conservation Service, has a peak discharge of 12,900 cubic feet per second at South Wilton and would

have a 0.5 percent chance of occurrence in any given year. This flood, as modified, has a peak discharge of 10,800 cubic feet per second.

EXTENT AND CHARACTER OF FLOODED AREA

21. Over 500 acres in Norwalk and Wilton, along the seven miles of river between the center of Wilton and tidewater, are subject to flooding in the event of a standard project flood. Above the center of Wilton, there are areas that would also be flooded but these were not subjected to a detailed investigation since the region is generally rural in character and, moreover, is within the zone of influence of the flood-retarding structures in the approved plan of the Soil Conservation Service.

The land in the flood plain below the center of Wilton is in a variety of ownerships and uses. Of particular significance, because of the vulnerability to severe flood damages, are the commercial and industrial properties bordering the river. Twenty-five industrial properties, 80 commercial ventures, a large electric power substation, and numerous residences are susceptible to flooding along this stretch of the river. Also susceptible to damage by high river stages is a branch line of the New Haven Railroad between Norwalk and Danbury, which is located in the flood plain for a considerable distance.

Flood flows in the Silvermine River, besides contributing to the flood problem along the Norwalk River in Norwalk, also cause flooding of residential properties along the course of this tributary in Norwalk, Wilton, and New Canaan.

FLOOD DAMAGES

22. RECURRING LOSSES

Following the record flood of October 1955, a damage survey was made of the area flooded in Norwalk by the Norwalk River. Review surveys, made in 1962 and 1963, updated the Norwalk data for the main river and extended the coverage of the data from the Norwalk-Wilton line to the center of Wilton on the main river and also appraised the losses which could be experienced on the Silvermine River in Norwalk, Wilton, and New Canaan. A recurrence of the record flood levels of 1955 in the portion of the basin below the center of Wilton would cause losses estimated at $7,950,000 under current

conditions. Of this total, $6,650,000 would be experienced along the Norwalk River in Norwalk with $3,750,000 being experienced below and $2,900,000 above Grist Mill Road. Of the remaining losses, $1,100,000 would be along the main stream in Wilton and $200,000 along Silvermine River.

23. AVERAGE ANNUAL LOSSES

Recurring loss data for various stages of flooding were combined with stage-frequency data to develop damage-frequency curves. The annual losses thus determined amount to $360,000 along the Norwalk River from the center of Wilton to tidewater at Wall Street in Norwalk. Of this total loss, $257,200 are along the approximate 2 mile length of the river between Grist Mill Road in Norwalk and the new Route 7 crossing in Wilton which is the reach of the recommended project.

To reflect the future condition that the flood plain below the center of Wilton will be completely built over by 1970 (as indicated in paragraph 15), a per-acre loss from flooding, developed for the latest research and development facilities in the basin, was applied to the area in which development can be reasonably expected, considering location, access, and the zoning requirements. There are 25 acres of such land in the project area. Based on a per-acre loss of $1,600 for present facilities, future losses without flood protection will be increased by $40,000. As the growth is projected to be complete by 1970, and it is unlikely that any protection project would be completed by that time, there is no discounting for time of development. Adding this $40,000 future loss to the annual losses that will be sustained by existing developments gives a total annual loss in the project area, under conditions expected over the next 100 years, of $297,200.

EXISTING CORPS OF ENGINEERS PROJECTS

24. FLOOD CONTROL

Improvement of 1,700 feet of the Norwalk River channel in the vicinity of the Perry Avenue bridge in Norwalk was completed in 1951. The work also included construction of an earth dike on the right bank and installation of steel sheet piling just downstream of the bridge. The project, constructed under the "Small Projects" authority of the Flood Control Act of 1948 (Public Law 858, 80th Congress), was designed to provide protection to about eight acres of land and 17 buildings against a flood of 4,000 cubic feet per second. The total cost of the work was $54,800 of which $52,200 was Federal.

25. NAVIGATION

The navigation improvement in Norwalk Harbor provides for a channel 12 feet deep from the outer harbor (Sheffield Island Harbor) to South Norwalk, thence 10 feet deep to the head of the harbor at Wall Street, Norwalk; an anchorage area 10 feet deep opposite Fitch Point, south of East Norwalk; a branch channel, 6 feet deep, from the 10-foot anchorage to East Norwalk; and an anchorage area 6 feet deep at East Norwalk. Controlling depths in the project vary from 4 feet to 11 feet. Modification of the improvement to provide additional small-craft facilities is currently under study.

IMPROVEMENTS BY OTHERS

26. SOIL CONSERVATION SERVICE

The Soil Conservation Service of the U. S. Department of Agriculture has developed a watershed work plan for the upper Norwalk River Basin. The approved plan includes land treatment measures; 2.3 miles of channel improvement above Wolfpit Road, located about one mile below the center of Wilton; and construction of five flood-water retarding structures in the headwaters, two of which would also provide for the improvement of wetland wildlife habitat. The plan provides flow-reduction benefits downstream as far as the Winnipauk Mill Pond Dam on the Norwalk River, about one mile south of the Norwalk-Wilton line. A summary of data on the water-retarding structures in the plan is given in Table 1; their locations are shown on Plate 1.

TABLE 1

FLOOD-WATER RETARDING STRUCTURES
WATERSHED WORK PLAN - SOIL CONSERVATION SERVICE
Norwalk River Basin, Connecticut

Site No.	Drainage Area (sq. mi.)	Storage Capacity (acre-feet) Sediment	Floodwater	Fish & Wildlife	Total
2	2.59	2	760	85	847
3	4.50(1)	4	1,455	-	1,459
4A	1.96	6	420	-	426
7A	1.54(2)	3	344	-	347
7B	1.16	6	437	62	505
Total	11.75	21	3,416	147	3,584

(1) Net below site No. 2
(2) Net below Site No. 7B

IMPROVEMENTS DESIRED

27. MEETINGS WITH LOCAL INTERESTS

During the conduct of the survey, a number of meetings were held with representatives of State and local interests to ascertain their desires for protection, to acquaint them with the progress being made on the survey, and to afford an opportunity for the exchange of ideas and comments on the study and the various plans of protection under consideration. At these meetings, local interests stressed the need for flood protection, particularly for the important industrial and commercial properties along the banks of the lower Norwalk River between the center of Wilton and Grist Mill Road in Norwalk.

28. PUBLIC HEARING

A public hearing was held at Wilton, Connecticut, on 26 May 1966, to present alternative plans for local protection in the study area and to obtain the views of interested parties on these and any other proposals with respect to flood control and allied matters in the Norwalk River Basin. Approximately 55 persons attended the hearing, including Federal, State, and local officials, representatives of local industrial, utility, and commercial interests and civic groups, a number of home owners and other interested individuals. The majority of those expressing opinions favored a plan for local protection along an alignment which follows the present course of the Norwalk River, or essentially the plan recommended in this report. A few residents on Arrowhead Road opposed the project since they feared it would remove trees and impair the aesthetics of their surroundings. (The plan selected for recommendation in this report will be designed and constructed to preserve the natural beauty of the area to the greatest extent possible. - See paragraph 39e.)

IMPROVEMENTS CONSIDERED

29. Studies of the Norwalk River Basin made for this report disclose that portions of Norwalk and Wilton along the Norwalk River will still be flood-prone after reductions in flood flows effected by the upstream watershed work plan of the Soil Conservation Service. Properties along Silvermine River also continue to be prone to flooding since the Soil Conservation Service plan has no effect on flows in this tributary basin.

Preliminary studies explored all feasible methods of reducing flood losses including construction of additional dams and reservoirs, dikes and flood walls, channel improvement projects, the diversion of flood waters, zoning of flood plains and flood proofing of buildings. Flood control by storage reservoirs was found impracticable. No additional effective storage sites could be found in the upper part of the Norwalk River Basin and the development of sites in the watershed of the Silvermine River was found to be not economically feasible owing to the high cost of land and improvements in the potential reservoir areas. High land values also made the cost of diversion to other basins excessive. Evacuation or extensive zoning of the flood plain was found not to be practicable because the flood-prone areas have already been highly developed for industrial, commercial, or residential usage.

Preliminary studies indicated the probability of a feasible channel improvement project for the project area - the reach of the Norwalk River extending downstream from the proposed Route 7 crossing of the river in Wilton to just below Grist Mill Road in Norwalk.

FLOOD CONTROL PLANS

30. PLANS CONSIDERED

Plans of protection selected for detailed study were all local channel improvement projects. They differed only in respect to alignment and the amount of flow for which protection would be designed.

31. ALTERNATIVE ALIGNMENTS

Two alternative alignments were considered. Both extend upstream about 10,000 feet from just below the Grist Mill Road bridge in Norwalk to the embankment of the proposed new Route 7 in Wilton. Each alignment would follow the general course of the river upstream about 4,000 feet to the Kent Road Bridge in Wilton. From this point, one alignment would continue along the course of the river while the other would parallel the railroad embankment northerly to the proposed Route 7 crossing. Both alignments would provide essentially the same protection and were found to be approximately equal in cost for the same design flows.

32. CONSIDERED DEGREES OF PROTECTION

For each alignment, the cost of protection was determined for flood flows of the following magnitude:

a. 6,400 c.f.s. - the maximum flood of record (October 1955) modified by the Soil Conservation Service plan.

b. 8,300 c.f.s. - the maximum flood of record, unmodified.

c. 10,800 c.f.s. - the standard project flood modified by the Soil Conservation Service plan.

d. 12,900 c.f.s. - the standard project flood, unmodified.

e. 14,300 c.f.s. - a flow approximately one-third greater than the modified standard project flood.

FIRST COSTS AND ANNUAL CHARGES

33. FIRST COSTS

The estimated total first cost of each of the considered plans, including that finally selected, was based on average prices bid for similar work in the Norwalk-Wilton area, adjusted to the 1966 price level. Property valuations are based on information from local officials and reflect values in recent sales in the area. All costs include an allowance for contingencies and for minor items of work which do not appear in the estimates. The costs for engineering and overhead are based on knowledge of the site and experience on similar projects. A summary of the first costs for the several considered plans is given in Table 2.

34. ANNUAL CHARGES

Average annual charges for the considered plans, also summarized in Table 2, are based on an interest rate of 3-1/8 percent and amortization of investment costs over a 100-year assumed project life. Allowances are also included to cover (1) the cost of annual maintenance and (2), for the two plans based on the higher flows of 12,900 and 14,300 cfs, which require the provision of a pumping station, the costs for operation and the interim replacement of equipment having an estimated life of less than 100 years. No loss of taxes is included as it is considered that the loss in taxable lands would be more than offset by the increase in the value of properties protected.

BENEFITS

35. FLOOD DAMAGE PREVENTION BENEFITS

Average annual flood damage prevention benefits accruing to the considered Norwalk-Wilton local protection projects and the floodwater retarding structures in the approved watershed plan of the Soil Conservation Service are based on the difference between the annual losses expected in the basin in 1970 without the protection that would be provided by the projects and the annual losses remaining after protection by the projects. The expected growth of the area contributes toward the total benefits (see paragraph 23). The benefits were derived considering the studied Corps projects acting in a system with the structures of the Soil Conservation Service plan without priority. The benefits to the several considered plans of the Corps of Engineers are summarized in Table 2.

TABLE 2

SUMMARY OF COSTS AND BENEFITS
(1966 Price Level)

CONSIDERED CHANNEL IMPROVEMENT PROJECTS
FOR FLOOD CONTROL

Norwalk River, Norwalk and Wilton, Conn.

			Selected		
Design Flows (cfs)	6,400	8,300	10,800	12,900	14,300
First Costs ($1,000)	3,890	4,200	4,300	5,400	6,050
Annual Costs	131,500	141,700	145,000	188,200	209,500
Annual Benefits(1)	188,200	190,200	193,200	200,000	206,900
Excess of Benefits over Costs	56,700	48,500	48,200	11,800	-2,600

(1) Based on total annual losses in project area of $297,200 (with no protection) and benefits of $68,000 annually to Soil Conservation Service plan.

36. INTANGIBLE BENEFITS

The protection to be provided by the project would also give benefits which, while significant, are not susceptible to monetary evaluation. Such intangible benefits include the elimination of the threat to life and danger of disease arising from polluted flood waters and the reduction of local resident's anxieties over the flood threat.

SELECTED PLAN

37. GENERAL

The plan selected is for channel improvement generally along the present course of the river, designed to afford protection in the event of a design flow of 10,800 c.f.s.

The selected alignment is the one preferred by local interests. It requires the dislocation of a lesser number of homes and trees in a residential area and less impairment to the natural beauty of the area. Moreover, it is no more costly than the alternative alignment which parallels the railroad in the upper end of the project area.

38. MAXIMIZATION OF BENEFITS

As indicated above, determinations were made of the costs and benefits of a series of plans predicated on five different flood flows. An examination of the results of these studies, as contained in Table 2, shows that the excess of benefits over costs for the several plans decreases as the magnitude of the design flow is increased. The maximum excess of $56,700 is realized with a plan based on the minimum design flow of 6,400 c.f.s. With flows of 8,300 and 10,800 c.f.s., the excesses are nearly equal, amounting to $48,500 and $48,200 respectively. With a design flow of 12,900 c.f.s., the excess drops markedly, to $11,800, and at a flow of 14,300 c.f.s., there is no excess of benefits. Although the maximum excess of benefits is realized with a design flow of 6,400 c.f.s., it is considered that this degree of protection, based on the flood of record as modified by the plan of the Soil Conservation Service, would not be adequate. Protection against the possible occurrence of a standard project flood is believed to be the minimum degree that should be proposed for this highly developed urban area. The plan based on a flood flow of 10,800 c.f.s. - the standard project flood modified by the Soil Conservation Service plan - provides this degree of protection and affords a substantial excess of benefits over costs. A plan based on this flow was, therefore, selected.

39. DETAILS OF SELECTED PLAN

The alignment and details of the selected plan of protection are shown on Plate 2. Pertinent elements of the plan are briefly described below.

a. Channel Improvement. The design channel would have a bottom width of 65 feet except for the lower 950 feet of its length in

Norwalk, where the width would be 60 feet. The channel side slopes would range from 4 on 1 in rock to 1 on 2 in earth cut to 1 on 2.5 where diking is provided, and would have rock slope protection. To concentrate low flows for fish, a V-shaped pilot channel, 3 feet deep with side slopes of 1 on 2.5 will be provided along the centerline of the main channel from the Grist Mill Road bridge to the upstream limit of the project.

b. Dikes and Walls. Where the channel passes through areas subject to inundation from overbank flooding under design flood conditions, dikes and walls will be provided along the banks of the channel to contain the flow. Together they total over 9,000 feet in length. The dikes would be of earth fill with stone protection on the riverside face and seeded topsoil on the landward face. Where dictated by space limitations, concrete walls or metal bin walls would be provided. The top elevation of dikes and walls would be three feet above the design water surface in the improved channel.

c. Interior Drainage. The proposed interior drainage systems will consist generally of collection drains behind and parallel to the dikes. These drains will discharge by gravity into the channel.

d. Relocations. The removal and reconstruction of four existing bridges will be required for the project. The bridges, in upstream order, are located at the Perkin-Elmer main plant, the Getman-Judd plant, and the former Manson Laboratories, now a Perkin-Elmer facility, and at Arrowhead Road. In addition, the Grist Mill Road bridge, at the lower end of the project, will be replaced by others as part of new Route 7.

e. Beautification. Since the project alignment is through urban and residential areas, the aesthetic effect of its construction and its final appearance are a paramount consideration. The selected alignment, which necessitates less removal of trees, was chosen largely with a view to preserving the natural state of the residential area at the upper end of the project. To insure that the completed work will have a pleasing appearance, landward slopes of dikes will be entirely grassed and planted with shrubs. Grassing of tops of dikes and landward slopes of cut and filled banks, required as a matter of erosion control, will also tend to enhance the appearance of the project. This work can be done at small added cost.

Contractor work areas will be kept minimal in size and be planned for minimal despoilment. Insofar as practicable, these areas will be restored to their natural state upon completion of the project.

After completion of the project, local interests will be required to make frequent inspections and maintain the project.

f. Degree of Protection. The selected project will provide complete protection for about 170 acres of land in the city of Norwalk and the town of Wilton in the event of a standard project flood modified by the upstream plan of the Soil Conservation Service. This is equal to a flood 30 percent greater than the maximum flood of record experienced in October 1955.

g. Project Costs and Benefits. The estimated total first cost of the selected plan is $4,300,000, of which $2,700,000 would be borne by the United States and the balance of $1,600,000 by local interests. The annual charges, including interest, amortization, and maintenance of the project, amount to $88,500 for the Federal share and $56,500 for the local participation, a total of $145,000. A breakdown of the estimated first cost and annual charges for the selected channel improvement project is given in Table 3.

The benefits attributable to the selected plan from the prevention of flood damages, as discussed in paragraph 35, amount to $193,200 annually.

TABLE 3

FIRST COSTS AND ANNUAL CHARGES
(1966 Price Level)
CHANNEL IMPROVEMENT PROJECT FOR FLOOD CONTROL
Norwalk River, Norwalk and Wilton, Conn.

	First Costs		
	Federal	Local	Total
Channel and canals	$ 550,000	-	$ 550,000
Dikes and walls	1,420,000	-	1,420,000
Interior drainage	280,000	-	280,000
Miscellaneous items	10,000	-	10,000
Lands and damages	-	1,220,000	1,220,000
Relocations	-	317,000	317,000
Sub-totals	2,260,000	1,537,000	3,797,000
Engineering &Design	240,000	34,000	274,000
Supervision & Adm.	200,000	29,000	229,000
Total First Cost	$ 2,700,000	$ 1,600,000	$ 4,300,000

TABLE 3 (cont'd)

	Annual Charges		
	Federal	Local	Total
Interest & amortization (1)	88,500	52,500	141,000
Maintenance	-	4,000	4,000
Total Annual Charges	$ 88,500	$ 56,500	$ 145,000

(1) Interest at 3.125%; amortization over 100 years.

NOTE: Preauthorization study costs in an estimated amount of $70,000 not included in above analysis.

ECONOMIC JUSTIFICATION

40. A comparison of annual charges of $145,000 with evaluated annual benefits of $193,200 gives a benefit-cost ratio of 1.3 for the selected improvement project.

PROPOSED LOCAL COOPERATION

41. In accordance with Section 3 of the 1936 Flood Control Act, as amended, local interests will be required to (a) provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project; (b) hold and save the United States free from damages due to the construction works; (c) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army. Under the provisions of (a), local interests will be required to provide, without cost to the United States, all relocations of buildings and utilities, highway bridges, sewers and related and special facilities. In addition, local interests will be required to provide assurances that encroachment on the improved channel will not be permitted. The total estimated cost of the proposed local cooperation is $1,600,000.

State and local officials have indicated a willingness and ability to fulfill the above conditions of local cooperation as evidenced by letters included in Appendix E.

COORDINATION WITH OTHER AGENCIES

42. The Soil Conservation Service of the Department of Agriculture and the Corps of Engineers have coordinated their studies of the Norwalk River watershed. In accordance with inter-agency agreements, the

Service studied upstream rural areas and the Corps, the downstream urban areas. The plans of the two agencies are complementary. The reduction in flood flows effected by the reservoirs in the Soil Conservation Service plan permit lower dike elevations than would otherwise be required in the Corps project to protect against the design flood.

The local protection plan recommended in this report has been reviewed by concerned Federal, State and local agencies, including the Fish and Wildlife Service of the U. S. Department of the Interior, the Connecticut State Water Resources Commission, the Connecticut State Highway Department, and officials of the city of Norwalk and the town of Wilton.

The Regional Director of the Bureau of Sports Fisheries, Fish and Wildlife Service, Department of the Interior, investigated the fish and wildlife aspects of the project and recommended the inclusion of a V-shaped pilot channel in the main channel of the project for the benefit of the seasonal fishery stocked by the State of Connecticut. This provision is included in the selected plan.

DISCUSSION

43. FLOOD PROBLEMS

Industrial, commercial, and residential properties in the flood plains of the Norwalk River and its tributaries have suffered damages from major floods during the past 30 years. A recurrence of the maximum recorded flood in the basin, that of October 1955, would result in estimated damages amounting to $7,950,000 under current economic conditions. Of this total, $7,750,000 would be sustained along the main stem of the Norwalk River in Norwalk and Wilton.

The Soil Conservation Service of the Department of Agriculture has developed a plan of protection for the upper part of the watershed which includes, in part, the construction of five floodwater retarding structures. These structures would reduce the flows downstream in a recurrence of the October 1955 flood by about 23 percent; in an occurrence of the standard project flood, for which the selected channel improvement project is designed, the SCS structures would reduce flows by about 16 percent, with a resultant reduction in flood levels in the lower basin. However, the losses remaining along the main river below the center of Wilton, after the reduction in stage effected by the Soil Conservation Service plan, are of sufficient magnitude to warrant the provision of other flood control measures.

44. SOLUTIONS CONSIDERED

Studies for this report have considered all practicable methods for solving the flood problems in the lower part of the Norwalk River Basin. The methods considered include the construction of dams and reservoirs, dikes and flood walls; channel improvement works; flood plain zoning; and the diversion of floodwaters.

Preliminary studies determined that the construction of reservoirs at sites other than those considered by SCS or the diversion of floodwater would not be economically feasible. Flood plain zoning would produce a partial but not immediate reduction of the flood problem. The State of Connecticut Water Resources Commission is empowered by law to establish stream encroachment lines beyond which no obstruction or encroachment shall be placed without a permit from the Commission. Such encroachment lines were established along the Norwalk River in Norwalk, below Grist Mill Road, in 1957, and in Wilton in 1965.

45. SELECTED PLAN

The selected flood control plan for the Norwalk River Basin consisting of the selected channel improvement project together with the upstream reservoirs in the Soil Conservation plan, constitute an integrated, coordinated plan for the basin. Consideration was given to a number of plans affording protection for design flows of varying intensity. A maximization of benefits would be obtained with protection against a flow of 6,400 c.f.s. that would be experienced in a recurring flood of record magnitude as modified by the upstream structures in the plan of the Soil Conservation Service. This degree of protection is not adequate for the area when present development and potential use of the flood plain is taken into account. A large excess of benefits over costs is secured with a project providing protection against a standard project flood as modified by the Soil Conservation Service plan and this was the degree of protection selected.

The alignment of the selected plan, generally following the present course of the river, minimizes the impairment of the present natural beauty of the area.

Two ponds, formerly gravel pits, located at the upstream end of the project, are presently used for swimming. The recommended project alignment preserves these ponds and permits their contined use and further development for recreation.

CONCLUSIONS

46. Urban and industrial areas along the banks of the Norwalk River in Norwalk and Wilton have sustained serious flood damages in the past and are continually faced with the threat of future flooding. The future occurrence of flood levels experienced in October 1955 would cause losses of $4,000,000 in the project area. In an occurrence of the standard project flood, losses in the area would amount to $6,700,000. The magnitude of the potential flood losses in the basin are sufficient to warrant the construction of a local channel improvement project in Norwalk and Wilton, with related dikes, flood walls, and other measures, all as described in this report. The selected project provides complete protection against a standard project flood modified by the Soil Conservation Service reservoirs. This flood is equivalent to one 30 percent greater than the 1955 flood of record unmodified by upstream storage.

The proposed plan, with an estimated first cost of $4,300,000, has a benefit-to-cost ratio of 1.3.

RECOMMENDATIONS

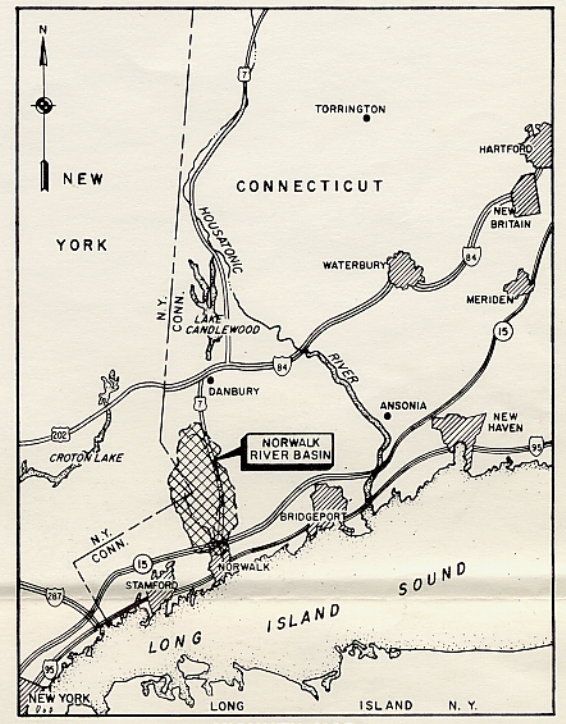
47. It is recommended that a project be authorized for construction providing for improvement of about 10,000 feet of the Norwalk River channel in Norwalk and Wilton, Connecticut, with associated dikes and floodwalls, all essentially as described in this report, and with such modifications thereof as, in the discretion of the Chief of Engineers, may be advisable. The presently estimated first cost of the project is $4,300,000, of which the estimated first cost to the United States is $2,700,000.

It is further recommended that the project be authorized subject to the condition that local interests, prior to construction, give assurances satisfactory to the Secretary of the Army that they will (a) provide without cost to the United States all lands, easements, and rights-of-way necessary for construction of the project; (b) hold and save the United States free from damages due to the construction works; (c) maintain and operate the works after completion in accordance with regulations prescribed by the Secretary of the Army; (d) provide, without cost to the United States, all relocations of buildings and utilities, highway bridges, sewers and related and special facilities; and (e) prevent encroachment on the improved channel.

The annual cost for maintenance of the project, a local responsibility, is estimated at $4,000.

F. B. SMITH
Lt. Col., Corps of Engineers
Acting Division Engineer

Attachments:
2 Plates
6 Appendices



VICINITY MAP

SCALE IN MILES
0 5 10 15

NORWALK RIVER BASIN

NORWALK-WILTON LOCAL PROTECTION PROJECT (RECOMMENDED)

LOCAL PROTECTION PROJECT (COMPLETED)

LEGEND

- RESERVOIR SITES STUDIED BUT NOT RECOMMENDED
- LOCAL PROTECTION PROJECT RECOMMENDED
- LOCAL PROTECTION PROJECT COMPLETED
- P.L. 566 RESERVOIR PROJECT BY SOIL CONSERVATION SERVICE (AUTHORIZED)
- CHANNEL IMPROVEMENT BY SOIL CONSERVATION SERVICE (AUTHORIZED)
- PROPOSED CHANNEL IMPROVEMENT BY CONNECTICUT STATE HIGHWAY DEPARTMENT

SCALE IN MILES
½ 0 ½ 1 MI.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION – CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY MWB	CK. BY P.J.M.

SUBMITTED
PROJECT ENGINEER
REVIEWED
CHIEF PLAN FORMULATION SEC.
APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH
APPROVED
CHIEF, ENGINEERING DIVISION
DATE MARCH 1967

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
NORWALK RIVER
BASIN MAP
CONNECTICUT AND NEW YORK

TO ACCOMPANY REPORT DATED: 15, MARCH 1967

SCALE AS SHOWN
DRAWING NUMBER

PLATE 1

MATCH LINE

SOUTH WILTON

PERKIN-ELMER

DIKE

CONN. LIGHT & POWER CO.

LOWER COPTS BROOK

AREA OF FLOODING OCT. 1955

KENNSETT AVE.

EXISTING BRIDGE

KENT ROAD

NORWALK RIVER

IMPROVED CHANNEL

METAL BIN WALL

DANBURY ROAD (7)

SHOPPING CENTER

PROPOSED NEW ROUTE 7

WATER TOWER

PERKIN-ELMER

WILTON NORWALK TOWN LINE

CITY LINE

CALDOR

NEW BRIDGE

GUARD RAIL

AREA OF FLOODING OCT. 1955

IMPROVED CHANNEL

N.Y., N.H. & H. R.R.

MAIN ST.

NORWALK

IMPROVED CHANNEL

GRIST MILL ROAD

NEW BRIDGE (BY OTHERS)

N

SCALE: 1" = 200'

200' 0 200' 400'

CHESTNUT HILL BROOK

CHESTNUT HILL BROOK DIVERSION

Proposed Diversion by Others

DIKE

STATOHM

PERKIN-ELMER

POND

RIVER

NORWALK

ROAD (7)

DIKE

NEW CHANNEL

POWER LINE

FLOODWALL

AREA OF FLOODING OCT. 1955

DIKE

PROPOSED NEW ROUTE 7

CONN. LIGHT & POWER CO.

N.Y., N.H. & H. R.R.

ARROWHEAD POND

ARROWHEAD ROAD

HOLSON

DIKE

WILTON ACRES

NEW BRIDGE

IMPROVED CHANNEL

SOUTH WILTON

DANBURY

DIKE

METAL BIN WALL

DIKE

PERKIN-ELMER (FORMERLY MANSON LAB)

NEW BRIDGES

GETMAN-JUDD

GRUMMAN HILL ROAD

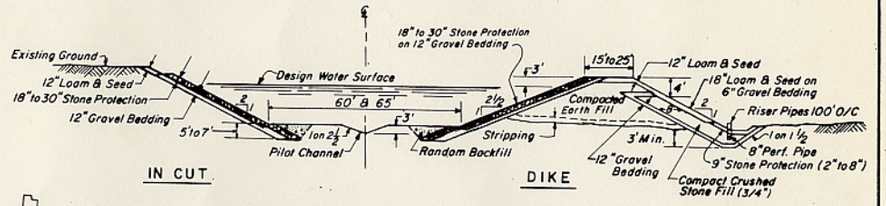
COPTS BROOK

UPPER

TRAK

DIKE

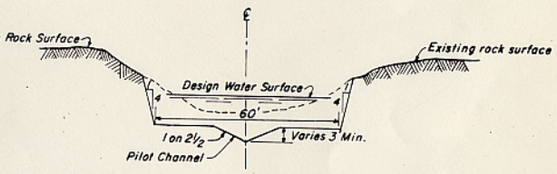
MATCH LINE



TYPICAL CHANNEL SECTION IN EARTH

SCALE: 1" = 20'

20' 0 20' 40'



TYPICAL CHANNEL SECTION IN ROCK

SCALE: 1" = 20'

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION – CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY M.W.B.	CK. BY P.J.M.

SUBMITTED: PROJECT ENGINEER

REVIEWED: CHIEF, PLANNING SECTION

APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH

APPROVED: CHIEF, ENGINEERING DIVISION

DATE: MARCH 1967

SCALE:

DRAWING NUMBER

TO ACCOMPANY REPORT DATED: 15, MARCH 1967

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
GENERAL PLAN

NORWALK RIVER CONNECTICUT

PLATE 2

ACKNOWLEDGEMENTS AND IDENTIFICATION OF PERSONNEL

1. The preparation of this report was administered by:

Colonel Remi O. Renier, Acting Division Engineer
John Wm. Leslie, Chief, Engineering Division
Edward W. Hill, Chief, Planning Branch
William A. Slagle, Jr., Chief, Plan Formulation Section

2. This report was prepared under the direction of Palmer J. Moe, Project Engineer.

3. The New England Division, Corps of Engineers, is appreciative of the cooperation rendered in connection with this study by personnel of other Federal agencies, State agencies, and local interests, particularly the following:

U. S. Soil Conservation Service
U. S. Fish and Wildlife Service
Connecticut State Water Resources Commission
Connecticut State Highway Department
Wilton Flood and Erosion Control Board
Norwalk Flood and Erosion Control Board

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Wilton Flood and Erosion Control Board
Norwalk Flood and Erosion Control Board

APPENDIX A

DIGEST OF PUBLIC HEARING

APPENDIX A

DIGEST OF PUBLIC HEARING

A public hearing was held in Wilton, Connecticut on 26 May 1966, to present the details of alternative plans considered for local flood protection along the Norwalk River in the city of Norwalk and town of Wilton, and to ascertain the views of local interests on these projects and any other proposals for flood control and allied purposes in the Norwalk River basin. Approximately 55 people attended the hearing, including representatives of Federal, State and local governments; a public utility, industrial, commercial, and civic interests; and interested individuals. Digests of the statements and letters received relative to the hearing are made a part of this Appendix.

Plan A, referred to in this appendix, is essentially the recommended plan. Plan B is the alternative plan which would provide a new channel for the Norwalk River parallel to the railroad tracks and west of the recommended alignment.

DIGEST OF PUBLIC HEARING - 26 May 1966
WILTON, CONNECTICUT

PART I - SPEAKERS AT THE HEARING

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Vincent J. Tite, First Selectman	Town of Wilton	Requests 50 copies of the project cost estimates.
Mr. DeEldon Philbrook, Workplan Party Leader	Soil Conservation Service, U.S. Dept. of Agriculture	Supports the Corps program and hopes for continued cooperation between the two agencies. Submits letter from N. Paul Tedrow, State Conservationist (see Part II Exhibit No.2)
Mr. Charles J. Pelletier, Hydraulic Engineer	Water Resources Comm. State of Connecticut	The Commission has been concerned with the flood problems on the Norwalk River for about 7 years. Plans, similar to those being presented at the hearing, were developed by the State which would provide almost the same degree of flood protection. There is a great and increasing need for the project. They made no evaluation of the alternative plans but do favor action to control floods.
Dr. Robert A. Norton, Chief, Hydraulics & Drainage	Highway Department, State of Connecticut	Submits letter from Howard S. Ives, State Highway Commissioner (see Part II, Exhibit No. 3)

PART I (Cont)

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Frederick C. Herot	Resident of Wilton	Asks if Mr. Ives letter implies that an economic justification had been made of their proposal? Believes design flood flow should not exceed that of October 1955. Asks what losses would be experienced if flood of October 1955 and one 30 percent greater should occur. Opposes Plan B; favors modified Plan A.
Mr. Mahlon D. Rose	Resident of Wilton	His home would be directly affected by project; is opposed to Plan B but would support a modified Plan A.
Mr. Robert V. Flouton	Resident of Wilton	Believes a dike adjacent to Arrowhead Pond would preclude the use of the pond. Asks how real estate values were used in the costs estimate and amount. Asks if the land was valued as residential or enterprise-industrial land?
Mr. Gordon M. Thomas	Resident of Wilton	Asks if recreational facilities are feasible only with Plan B-1, and where the dike would be located with relation to the pond?
Mr. James A. Skardon	Resident of Wilton	Questions why alternate plans were prepared?
Mrs. Mahlon D. Rose	Resident of Wilton	Wonders if the collapse of the upstream dams was the cause of flooding in Wilton.

Part I (Cont)

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Martin Becker	Tennessee Gas Pipeline Co.	Asks if proposed channel work would interfere with pipeline at Armstrong Rubber Plant.
Mr. James P. Gregory, Attorney	Perkin-Elmer Corp.	Summarizes and submits letter from Company (see Part II, Exhibit No. 7)
Mr. Robert V. Flouton	Resident of Wilton	Asks why the difference in design floods by SCS and Corps. Submits letter (see Part II, Exhibit No. 11)
Mr. Charles J. Pelletier, Hydraulic Engineer	Water Resources Comm., State of Connecticut	Surprised that remarks tonight considered the project design flood too large. Believes that it is none too large. Floods have occurred on the Farmington River considerably greater than that experienced in Norwalk basin in 1955, and may occur again.
Mr. Robert Olsen	Resident of Wilton	Asks whether the Town of Wilton will determine its choice or disapproval of Plan A or Plan B by a public vote? If the Town purchases the land for the project and the cost is less than that given here tonight would it preclude Federal participation in the project? Are there any workable minimums which limit the interest of the U.S. Army Engineers in a flood control project? A possibility of downgrading the degree of protection? (Ed. Note: Hearing Officer replies in the negative.)

Part I (cont)

Speaker	Interest Represented	Improvement Desired and/or Comments
Mrs. Ruby W. Thomas	Resident of Wilton	Prefers Plan A to Plan B.
Mr. John Howland Snow	Resident of Wilton	Says many prior hearings have been held on flood protection in which channel improvements and dry reservoirs were considered. Has been told that it is feasible to impound water until flash point has receded downstream. Says this should reduce the flood flow for the project presented at the hearing.
Mr. Stanley J. G. Brown	Resident of Wilton	He would favor a modified Plan A. If Plan B work precedes the construction of Route 7, he asks would a bridge be provided for home located west of the railroad track? (Ed. Note: Hearing Officer stated that the home was considered as removed as part of Route 7 work.)
Mr. Gordon M. Thomas	Resident of Wilton	Asks, if recreation facilities are provided, would it be open to the public? (Ed. Note: Hearing Officer answered that it would be open to all on an equal basis.)
Mr. John Fleming	Resident of Wilton	The watershed work plan report states that the reduction in flood water would be 42 and 32 percent between Arrowhead Road and Kent Road. Does the Corps of Engineers agree with this reduction? (Ed. Note: Hearing Officer pointed out that these percentages are based on SCS design flow, not Corps standard project flood.)

Part I (cont)

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Richard L. Wayne	Resident of Georgetown	Referring to a statement made at the hearing that the amount of flood water would be about the same between Wilton Center and Grist Mill Road, speaker says that he believes there would be more water downstream because of the runoff from buildings and pavements. A flood could be quite dangerous in Wilton. People should not be complacent about it because of the dry periods.
Mrs. Frederick Herot	Resident of Wilton	Since the benefit to cost ratio requirement has been satisfied she believes that human values concerning recreation, lovely ponds and park areas should be considered. Because beautification of the land is a national policy, would like some assurance that it is of value to the Corps of Engineers. (Ed. note: Hearing officer states a contract has been made with a commercial firm to study recreation and tourism in all states in the Connecticut River basin, and he hopes that recreation will be developed based on the study.

Part I (cont)

Speaker	Interest Represented	Improvement Desired and/or Comments
Mr. Richard L. Brinkerhoff, Attorney	Mr. George J. Santry, Landowner	Represents the owner of land located north of Arrowhead Road zoned as design enterprise. There is a diversity of interest between residential land owners to the south and his client. In terms of development of the design enterprise land which is now bisected by the Norwalk River, a relocation of the river to the west, adjacent to the railroad track, as shown on Plan B, would be the most effective utilization of the land.
Mr. John Fleming	Resident of Wilton	Asks why the cost of flood protection work is so much more downstream than upstream of Wolfpit Road. Why can't the lower project provide a senic river similar to that proposed for the upstream work.

PART II - LETTERS AND STATEMENTS READ AT HEARING

Exhibit No.	Writer	Interest Represented	Summary of views or comments
1	Honorable Abraham Ribicoff, U.S. Senator	State of Connecticut	In letter dated 17 May 1966, the Senator states that every effort must be made to insure that the terrible loss of life and property caused by the flood of 1955 does not occur again. An effective flood control project for the Norwalk River will be an important step in this direction.
2	N. Paul Tedrow, State Conservationist	Soil Conservation Service, U.S. Dept. of Agriculture	Submits copy of Norwalk River Watershed Work Plan developed under Public law 566 with letter dated 26 May 1966. He indicates pleasure that preliminary studies by Corps of Engineers indicate feasibility of local protection work in Wilton. Plan of P. L. 566 work in the upper basin area, forwarded to Bureau of the Budget on 30 December 1965, recognized the need for protection in the downstream area covered by the Corps of Engineers. He looks forward to continued cooperation between the two Departments.
3	Howard S. Ives, Commissioner	Highway Department State of Connecticut	In letter dated 25 May 1966, the Commissioner indicates that plans will require close coordination among the U.S. Soil Conservation Service, the U.S. Army Engineers and the Connecticut Highway Dept., especially in the vicinity of the proposed crossing of the Norwalk River by relocated Route U.S. 7 just south of Route 33 interchange The Dept. will continue to cooperate in the development of plans of the three agencies.

Part II (cont)

Exhibit No.	Writer	Interest Represented	Summary of views or comments
4	Mr. Alfred J. Hunyadi, Asst. Director	Board of Fisheries and Game, State of Conn.	In a letter dated 5 May 1966, incloses and concurs in a report dated 15 April 1965 by the U.S. Fish & Wildlife Service, Bureau of Sport Fisheries and requests that it be read into the hearing record.
4A	Mr. Travis S. Roberts, Acting Regional Director	Dept. of the Interior, Fish & Wildlife Service	Report, dated 15 April 1965, restated agreement to modify pilot channel to "V" shape with 3-foot depth and 15-foot top width to concentrate flows to prevent fishery losses.
5	Mr. H. Donald Harris Vice-Chairman	Wilton Zoning and Planning Comm.	In letter dated 26 May 1966, the Commission notes that new developments have been relatively unhindered by establishment of encroachment lines. Plan B is unacceptable as it would adversely affect the Arrowhead Road residential community and seriously reduce Manson Lab parking area. Plan A should be revised to preserve trees and create a recreation area. In summary: consider reducing flood protection design, landscaping, channel improvement, and sharing bridge facilities to reduce costs.

Part II (Cont)

Exhibit No.	Writer	Interest Represented	Summary of views or comments
6	Mr. Thomas T. Adams, Attorney	Arrowhead Community Association, Inc.	Letter dated 26 May 1966, states that all Arrowhead homes will be affected by either plan; questions the value of the improvements; opposes Plan B in any form; and would support a modified version of Plan A that would preserve the trees along the east bank of the Norwalk River. Recreational facilities could be provided at the two gravel pits north of Arrowhead Road.
7	A.H. Munkenbeck, Jr. Secretary and General Counsel	Perkin-Elmer Corp.	In letter dated 26 May 1966, the Company favors Plan A with reservations and opposes Plan B, since the latter would interfere with property rights of land owners, destroy a septic field, and limit building expansion at their new plant (Manson Lab). Questions the high degree of protection; the replacement of bridge at their new plant; and wants to know whether the project would affect their alternative fire protection water tower and river storage basin at their main plant. Regardless

Part II (cont)

Exhibit No.	Writer	Interest Represented	Summary of Views or comments
7 (cont)	A. H. Munkenbeck, Jr. Secretary and General Counsel	Perkin-Elmer Corp.	of plan adopted, Grist Mill Road bridge should be replaced as problem No. 1.
8	Leon H. and Beatrice B. Reynolds	Residents of Wilton,	In letter dated 25 May 1966, they and the members of Arrowhead Road Association are distressed because dikes would replace the natural beauty of the area. Believe upstream flood control measures could take care of any future floods. Do not favor any plan; however, would accept a modified Plan A, retaining the area in natural state and the trees on the east bank of the river.
9	Stanley and Ruth Brown	Residents of Wilton,	In letter of 26 May 1966, express concern over and disapproval of Plan B. This plan would eliminate two residences and destroy the very heart and nature of the Arrowhead Road community. They believe project design is excessive. If flood protection is necessary, a modified Plan A, preserving the trees on the east bank would be acceptable. Questions the expenditure of such great sums of money for flood protection.

Part II (cont)

Exhibit No.	Writer	Interest Represented	Summary of views or comments
10	Mr. Louis L. Clemons	Resident of Wilton	In letter of 19 May 1966, writer strongly opposed to Plan B. This plan would eliminate two homes, destroy the natural beauty of the Arrowhead residential area, and depreciate the value of the remaining homes. Recommends Plan A with modified channel alignment. Channel would follow the course of river from Grist Mill Road bridge to about 500 feet upstream of Manson Lab., then in a straight course just behind the Holson building; finally in a northwest direction to proposed Route 7, thus preserving the large trees and vegetation located along the east bank of the river. Should provide recreational facilities at the two gravel ponds at the upper end of project for Plan A. This plan will lessen the burden placed on the residential area of Arrowhead Road. If any other plan than Plan A is adopted, consideration should be given to purchase at fair market value of any residential property located in the Arrowhead Road Area.

Part II (cont)

Exhibit No.	Writer	Interest Represented	Summary of views or comments
11	Mr. and Mrs. Robert V. Flouton	Resident of Wilton	In letter dated 25 May 1966, they state that prior to the hearing no mention was made of an alternative Plan B. Why is there a difference between two Federal agencies in designing for flood occurrences? They object strenuously to contemplated expenditures of both Federal and municipal funds for either Plan. Plans do not show any methods of preserving the beauty and natural vegetation of the Norwalk River valley. Question the need for a flood project of this size. Design features exceed any flood occurring within the last 100 years. Plan B would destroy the value of their home and property as well as the adjoining Association park and recreation land. Were not served notice of hearing by the U.S. Army Engineers or the Wilton Flood and Erosion Control Board. Object to Plan A as it would obliterate scenic, vegetation, and conservation features of Norwalk River valley. (Ed.Note: Hearing Officer explains the basic differences in methods of approach used by the two agencies)

APPENDIX B

HYDROLOGY AND HYDRAULIC ANALYSIS

APPENDIX B

HYDROLOGY AND HYDRAULIC ANALYSIS

TABLE OF CONTENTS

APPENDIX B

HYDROLOGY AND HYDRAULIC ANALYSIS

1. INTRODUCTION

This appendix presents a general description and climatological and hydrological data for the Norwalk River basin. Analyses of floods of record, development of synthetic floods, effectiveness of various flood control measures, and an hydraulic analysis of the recommended plan are described in detail.

GENERAL DESCRIPTION

2. NORWALK RIVER BASIN

The Norwalk River basin, located in Fairfield County in southwestern Connecticut and eastern Westchester County, New York, has a total drainage area of 58 square miles. The overall length of the basin in a north-south direction is about 14 miles and the maximum width about 6 miles. A map of the basin is shown on Plate B-1. The moderately rolling topography is characterized by rounded hills and relatively flat valleys. Except for the coastal region which is intensively developed for industrial, commercial, and residential uses, the basin has a rural character, is covered with trees and shrubs, and abounds in low swampy areas. There are several water supply developments in the basin located principally in the Silvermine River watershed.

3. NORWALK RIVER

The Norwalk River rises in the western part of Fairfield County in the town of Ridgefield, Connecticut. The river then flows in a generally southward direction, and empties into Long Island Sound within the city of Norwalk. It has a total length of 20.4 miles. The main river channel from Ridgefield to tidewater, at about river mile 1.5 in Norwalk, has an average slope of 28 feet per mile. A profile of the Norwalk River is shown on Plate B-2. The mile and a half long tidal estuary, from the mouth at Norwalk Harbor to Wall Street bridge in Norwalk, is navigable and is widely used by commercial and pleasure boating interests. Principal tributaries of the Norwalk River are the Silvermine River and Comstock Brook.

a. Silvermine River. The watershed of the Silvermine River drains 23 square miles, a considerable portion of which has been developed for water supply purposes by private industry. The river has a total length of 10.7 miles and an average slope of 60 feet per mile from the town of Ridgefield to the confluence at river mile 3.2 on the Norwalk River.

b. Comstock Brook. Comstock Brook joins the Norwalk River at river mile 8.7 near Wilton Center. It has a drainage area of 7.3 square miles and an overall length of 6 miles. The average slope from the headwater to its mouth is about 86 feet per mile.

4. CLIMATOLOGY

The Norwalk River basin has a variable climate. The New England south coastal region frequently experiences periods of heavy precipitation produced by local thunderstorms and larger weather systems of tropical and extratropical origin. The basin lies in the path of the prevailing "westerlies" which generally travel across the country in an easterly or northeasterly direction, producing frequent weather changes.

a. Temperature. The mean annual temperature of the Norwalk River Basin is about 50°F. Average monthly temperatures vary widely throughout the year, ranging from 70°F. in July and August to 28°F. in January and February. Extremes in temperatures range from occasional highs of above 100°F. to lows of -20°F. Freezing temperatures may be expected from the latter part of October until mid-April. The mean, maximum, and minimum monthly and annual temperatures at Norwalk, are shown in Table B-1.

b. Precipitation. The mean annual precipitation over the Norwalk River basin is about 48 inches. The distribution of the mean precipitation is approximately uniform throughout the year. However, monthly extremes ranged from a high of 17.23 inches in October 1955 to 0.03 inch in May 1903. Table B-1 summarizes the monthly and annual precipitation at Norwalk.

c. Snowfall. The average annual snowfall over the Norwalk River Basin is about 34 inches. The mean, maximum, and minimum monthly and annual snowfalls at Norwalk are shown in Table B-1.

d. Snow cover. Significant depth of snow covers the basin sporadically from December through mid-March. The water content of the snow cover, however, seldom exceeds 1 inch and continuous cover lasts only for short periods due to the moderating effect of Long Island Sound.

e. Storms.

(1) General. The Norwalk River basin has experienced four general types of storms:

(a) Extratropical continental storms which move across the basin under the influence of the prevailing westerlies;

(b) Extratropical maritime storms which originate and move northward along the eastern United States coast;

(c) Storms of tropical origin; some of which attain hurricane magnitude;

(d) Thunderstorms produced by local convective activity or more general frontal activity.

(2) September 1938 storm. A stationary cold front along the Atlantic coast was overrun by a rapidly moving tropical hurricane, producing record-breaking rainfall over large areas of Connecticut, Massachusetts, Vermont and New Hampshire. The storm started as light rain which gradually increased in intensity over a 4-day period, becoming a heavy downpour. This sequence of rainfall was especially conducive to high peak discharge due to the filling of ponds, lakes and swamps and saturation of the soil surface before the intense rainfall occurred. Moreover, rainfall during the previous month had been heavier than normal. The storm totals were 10.66 inches in Norwalk and 10.06 inches in Wilton for the period 17-21 September. The hurricane produced abnormally high tides in Long Island Sound and in the lower Norwalk River.

(3) March 1953 storm. The series of storms which struck New England during March 1953 produced record monthly amounts at many locations. The storms were due primarily to a series of low pressure centers developing along the middle Atlantic coast that moved northward to New England under the influence of moisture laden southerly winds aloft. The normal northeastward movement of these weather systems was blocked by high pressure centers that persisted for most of the month over the northwestern Atlantic Ocean. Rainfall over the Norwalk River basin averaged about 7 inches for the most intense period of 12-16 March 1953.

(4) August 1955 storms. In August 1955, two hurricanes (Connie and Diane) struck the southern New England area within a one-week period. The storm which accompanied hurricane Diane on the 17th to 20th produced record floods in many streams. These rains fell on ground previously saturated by rainfall from hurricane Connie which occurred on the 11th to 15th. Rainfall totals at Norwalk for the 2 storm periods were 8.23 and 13.39 inches, respectively. Tides along the Connecticut coast were not abnormally high during these storms.

(5) October 1955 storm. The storm of 14-17 October originated as an extratropical low pressure area off the Florida coast. The low pressure system became stalled off the New Jersey coast when a strong high pressure area located in the vicinity of Labrador and the Gulf of St. Lawrence blocked its northward course. The warm, moist tropical air circulating about the low pressure area overran the cooler air mass of the high pressure system and intense rainfall resulted over much of southern New England. This storm produced record floods in the Connecticut coastal streams. Rainfall over the Norwalk River basin averaged about 13 inches for the period 14-17 October. In addition to the fresh water flooding, tides in Long Island Sound reached a maximum of about 4 feet above the predicted normal. These abnormal tides occurred over a period of about 72 hours.

TABLE B-1

CLIMATOLOGICAL DATA AT NORWALK, CONN.

	MONTHLY TEMPERATURES (Degrees Fahrenheit)			MONTHLY PRECIPITATION (In Inches)			MEAN MONTHLY SNOWFALL (Average Depth in Inch)
	Period of Record 1892 - 1965			1892-1965			1898-1964
Month	Mean	Maximum	Minimum	Mean	Maximum	Minimum	El. 37 feet msl
January	27.7	70	-22	3.51	7.35	.54	8.6
February	28.1	70	-20	3.40	7.46	.49	10.1
March	36.6	87	- 6	4.12	12.42	.23	5.8
April	47.5	92	9	3.81	8.60	.77	1.3
May	58.5	96	24	3.89	10.78	.03	0
June	67.3	100	34	3.29	10.54	.14	0
July	72.3	102	42	4.05	11.81	.65	0
August	70.2	104	34	4.66	15.80	.27	0
September	63.6	102	28	3.88	15.64	.23	0
October	52.9	90	16	3.62	17.23	.16	0.1
November	41.8	83	- 4	3.80	8.86	.76	1.2
December	30.6	71	-16	3.74	8.58	.85	7.0
ANNUAL	49.8	104	-22	46.58	62.95	33.67	34.3

5. STREAMFLOW

Since September 1962, the U.S. Geological Survey has operated a recording stream gaging station at South Wilton, Connecticut. Due to the short period of record of this station, only streamflow records for the Saugatuck River near Westport, a contiguous watershed, are shown in Table B-2.

TABLE E-2

MONTHLY RUNOFF
(In cfs/sq. mi.)

Saugatuck River Near
Westport, Connecticut
DA = 77.5 Square Miles

Month	Mean	Maximum	Minimum
January	2.25	5.75	0.60
February	2.38	4.62	1.27
March	4.22	8.14	1.86
April	3.27	5.38	1.15
May	2.13	3.60	0.83
June	1.01	2.81	0.15
July	0.42	1.37	-0.06
August	0.52	3.98	-0.07
September	0.34	1.19	-0.01
October	0.90	11.20	-0.13
November	1.71	6.53	0.19
December	2.17	4.27	0.37
ANNUAL	1.78	2.81	0.95

6. TIDE DATA

The mean tide range in Norwalk Harbor is 7.1 feet which extends from mean low water 3.3 feet below mean sea level to mean high water of 3.8 feet above mean sea level. Mean high and maximum high spring tide levels are about 4.4 and 5.7 feet msl, respectively. The maximum experienced tide is 10.8 feet which was produced by the hurricane of September 1938. A tide-frequency curve for Norwalk Harbor, based on 147 years of combined tide gage records, high water marks, and historical accounts is shown on Plate B-3.

7. FLOOD HISTORY

a. General. Prior to 1930, the history of floods in the Norwalk River is very sketchy. Major, basin-wide flooding has been relatively infrequent; however, minor damages have been experienced repeatedly in low-lying developments at isolated locations on the flood plain. Floods have generally resulted from intense rainfall alone although records indicate that snowmelt runoff has also contributed to high flows on occasions. Except in the lower reach below Wall Street in Norwalk, abnormally high tides do not affect the level of flooding in the Norwalk River.

b. Major floods.

(1) September 1938. The hurricane of September 1938 produced record tide levels in the lower reach of the Norwalk River below the Wall Street bridge. The flood accompanying the hurricane washed out a section of Bishop's Dam located between Cross Street and New Canaan Avenue, and inundated low areas adjacent to the river near Perry Avenue. The peak flow in the river was estimated to be 3,500 cfs below the confluence of the Silvermine River and 2,000 cfs at Perry Avenue on 21 September.

(2) March 1953. On 13 March the Norwalk River overflowed its banks in Norwalk and caused minor damage to a utility company, one manufacturing plant and several residences. No estimate of the discharge was made.

(3) October 1955. The flood which resulted from the storm of 14-17 October greatly exceeded all previous recorded events in the Norwalk River. The average rainfall over the basin for the 72-hour period was about 13 inches. Abnormally high tides accompanied the storm and the water level in Norwalk Harbor reached elevation 7.9 feet msl.

The peak discharge on 16 October near Branchville (drainage area 7.5 square miles) was estimated by the U.S. Geological Survey to be 3,100 cfs. The estimated peak discharges during this flood at Wilton, South Wilton and Norwalk are shown on table B-3. Hydrologic data for the October 1955 flood are shown on Plate B-5.

TABLE B-3

OCTOBER 1955 AND
STANDARD PROJECT FLOODS

Location	Drainage Area (sq. mi.)	October 1955 Flood (cfs)	Natural SPF (cfs)	SPF Modified by SCS Plan (cfs)
Norwalk River				
Wilton	25.9	7,800	10,700	8,400
South Wilton	31.3	8,300	12,900	10,800
Perry Avenue (Norwalk)	33.0	8,600	13,700	11,500
Wall Street (Norwalk)	58.0	14,000	19,000	17,000
Silvermine River				
At Mouth	23.0	6,600	8,800	-

The October 1955 flood caused extensive loss throughout the Norwalk River basin, damaging many buildings, washing away several bridges and inundating the communities of Wilton, South Wilton, and Norwalk to considerable depths.

The October 1955 flood profile in the Norwalk River, shown on Plate B-2, was determined from a high water mark survey following the flood.

c. Flood frequency. The frequency of percent change occurrence of peak discharges at selected locations along the Norwalk River was determined by procedures described in ER 1110-2-1450. Because of the short period of discharge records on the Norwalk River (1962 to present), the discharge-frequency curves were developed by relationships with the Saugatuck River near Westport, Connecticut and the Still River near Lanesville,Connecticut. The statistical analyses for these stations were based on about 35 years of record. A skew coefficient of 1.0 was adopted for all locations in the basin. Discharge-frequency curves for selected locations in the basin are shown on Plate B-4.

8. ANALYSIS OF FLOODS

The flood of October 1955 was analyzed in detail in order to determine the hydrologic characteristics of the Norwalk River basin. These studies provided the basis for the derivation of synthetic floods. General conclusions resulting from the analysis of the floods of record in the basin are as follows:

a. The Norwalk River basin contains numerous swamps which provide

effective natural valley storage during floods.

b. The lower reach of the river, below Wall Street bridge, is a tidal estuary and adjacent properties are susceptible to infrequent shallow flooding from a combination of stream flow and abnormal tides.

c. The Norwalk River is a coastal basin and floods usually have resulted from intense or prolonged rainfall alone. However, in March 1936 and March 1953, snowmelt runoff also contributed to the high flows.

d. The New York, New Haven and Hartford railroad bridge between Wall and Cross Streets in Norwalk is an obstruction to major floodflows, but does not affect flows within the proposed project area.

9. STANDARD PROJECT FLOOD

a. General. Standard project flood hydrographs were developed for the Norwalk River at Wilton, South Wilton, Perry Avenue (above confluence of Silvermine River), and at Wall Street in the city of Norwalk. These hydrographs were derived from synthetic unit hydrographs and standard project storm rainfall, as described in EM 1110-2-1411.

b. Standard project storm. The standard project storm was oriented over the basin so as to produce the most critical conditions at the above locations. The average basin rainfall was determined for a drainage area of 50 sq. miles. Losses from infiltration, surface detention, and transpiration were assumed at a maximum rate of 0.1 inch per hour. A summary of the adopted standard project storm data are as follows:

Standard Project Storm Rainfall (24 hours)	11.60 inches
Total Losses	2.19
Rainfall Excess (24 Hours)	9.41 inches
Maximum 2-Hour Rainfall	4.74 inches

c. Unit hydrographs. Six-hour synthetic unit hydrographs, shown on Plate B-5, were developed for the index stations at Wilton and South Wilton. Pertinent data on these unit hydrographs are as follows:

Wilton-Drainage area 25.87 square miles

t_p = 5.0	Ct = 1.35
q_p = 51.5	$640C_p$ = 260
W50 = 9.3 hours	$(LLca)^{.3}$ = 3.7
W75 = 4.9 hours	

South Wilton -Drainage area 31.25 square miles

t_p	= 5.5	Ct	= 1.34
q_p	= 51.3	$640C_p$	= 280
W50	= 9.5 hours	$(llca)^{.3}$	= 4.1
W75	= 5.0 hours		

d. Standard project flood. Rainfall excess values of the standard project storm were applied to the adopted 6-hour unit hydrographs at Wilton and South Wilton. The resulting standard project flood hydrographs are shown on Plate B-5. Standard project flood discharges at other selected locations in the basin were determined from relationships of the hydrologic characteristics. Peak ordinates of the natural standard project floods and as reduced by the Soil Conservation Service (SCS) system of reservoirs are shown on preceeding Table B-3.

10. PROJECT DESIGN FLOODS

Project design floods at the damage areas in Wilton, South Wilton and Perry Avenue and Wall Street in Norwalk were generally equal to the developed standard project flood as modified by the SCS system of dams. The standard project flood (12,900 cfs) in the recommended project area at South Wilton is about 55 percent greater than the October 1955 record flood (8,300 cfs).

FLOOD CONTROL PLANS

11. GENERAL

The recommended flood control plan for the Norwalk River basin was developed jointly by the U.S. Department of Agriculture, Soil Conservation Service (SCS) and the Corps of Engineers and includes reservoirs and local protection projects. The most feasible plan was found to be a system of floodwater retarding structures in the headwater area above the center of Wilton and channel improvement projects at Branchville, Georgetown, Wilton and South Wilton.

12. SOIL CONSERVATION SERVICE WATERSHED WORK PLAN

The approved SCS watershed work plan for the Norwalk River basin, shown on Plate B-1, includes land treatment measures, 3 floodwater retarding structures, 2 multi-purpose floodwater retarding and wildlife enhancement structures and channel improvements. The SCS report states that "the plan is based on a level of protection against floods expected to occur up to a frequency of about once in a hundred years." The average stage reduction attributable to these projects in the reach from the center of Wilton to South Wilton during a recurrence of the October 1955 flood under existing conditions is about 1 foot. The effects of the watershed work plan on the record flood of October 1955, and the standard project flood are shown on

Plate B-5.

13. RECOMMENDED CORPS OF ENGINEERS LOCAL PROTECTION PLAN

a. General. The recommended Corps of Engineers local protection plan for South Wilton extends from Grist Mill Road bridge in Norwalk to the proposed relocated Route 7 river crossing in South Wilton includes dikes, floodwalls, channel improvement, and interior drainage facilities.

The channel generally consists of a 60'-65' wide trapezoidal section with 4 on 1 side slopes in rock, 1 on 2 sideslopes in earth cut, and 1 on 2½ side slopes in diked sections. The proposed channel has an invert slope of 0.424 percent from about Station 4+00 to Station 95+70, and a stepped invert in the rock cut section between Stations 95+70 and 97+30. A triangular-shaped pilot channel will be constructed along the centerline to insure self-cleaning velocities to minimize meandering, and to concentrate flows for fish during low flow periods. Channel sections were determined by the physical limitations within the channel reach and the 65-foot wide Kent Road bridge which is to be retained.

The proposed project will provide the most efficient overall combination of channel and dike cross sections and will minimize the costs of modification of river crossings and interior drainage facilities. The project will provide a high degree of protection to the largely commercial and industrial developments on the South Wilton-Norwalk flood plain. The plan of improvement and profiles are shown on Plates B-6 and B-7. Other projects studied by the Corps are described in Appendix D.

b. Water surface profiles. The water surface profile of the standard project flood was computed by conventional backwater methods assuming roughness coefficients of .030 in earth and .040 in rock. Principal hydraulic controls within the reach will be: (1) Winnepauk dam (existing), (2) a high velocity channel excavated in rock above the Grist Mill Road bridge, (3) Perkins-Elmer Company bridge (to be reconstructed), (4) Kent Road bridge (existing), (5) Getman-Judd Lumber Company bridge (to be reconstructed), (6) Perkin-Elmer bridge (formerly Manson Laboratories) (to be reconstructed), and (7) Arrowhead Road bridge (to be reconstructed). The average subcritical velocities will vary from about 8 to 13 fps except in the rock-lined channel above Grist Mill Road bridge where supercritical flow may attain a velocity of 18 fps.

c. Superelevation. The horizontal curvature of the improved channels near Manson Laboratories and the Perkin-Elmer Company will produce a superelevated water surface. The computed superelevation varied from 1.0 to 1.5 feet. Adequate heights of protection will be provided in the channel reaches where superelevation is determined to be necessary.

d. Tractive forces and riprap requirements. Stone riprap protection will be provided on the riverside slope of dikes, metal bin-type walls, and on the channel side slopes where the natural materials have been disturbed.

The maximum unit tractive forces were computed and the minimum average riprap thicknesses (D_{50} minimum) were determined by methods described in the draft report: "Criteria for Graded Stone Riprap Channel Protection," dated 20 April 1966. From chart 9 of the subject draft, assuming a specific weight of stone of 165 pounds per cubic foot, the resulting D_{50} minimums vary from 0.7 foot in the straight channel reaches to 1.4 feet beneath Kent Road bridge. The maximum unit tractive forces vary from 2.9 to 5.8 pounds per square foot.

e. Freeboard. A minimum freeboard of 3 feet will be provided between the design water surface and the top of protection. The design water surface upstream of the existing Kent Road bridge will be at about the elevation of the lowest member. Three feet of freeboard is provided at all reconstructed bridges.

INTERIOR DRAINAGE

14. CRITERIA

The interior drainage system has been designed for a 10-year storm (2.0 inches/hour) coincident with low river and a 1-year storm (1.2 inches/hour) coincident with a high river stage. The drain layout is such that no ponding caused by backup in the new drains would occur for either of the above conditions. For this reason, neither sluice gates nor flap gates have been provided on any of the new gravity outlets. A 2-year storm, coincident with a high river stage, would cause only slight ponding in a small portion of the low area located on the west side of the Norwalk River at Station 29+00.

15. GENERAL

The new interior drainage system will consist, generally, of collection drains behind, and parallel to, the dike. These drains will discharge, by gravity into the Norwalk River. Since the hydraulic gradient of the river (including obstructions) is steeper than the hydraulic gradient of the interior drains, there is no backup of flow into the drains to cause water to flow out of the manholes, even with a high river stage coincident with a 1-year storm. The system is shown in detail on Plates B-6 and B-7.

16. EXISTING DRAINS

Existing drains and culverts which discharge into the river, by way of ditches and streams, will be extended by piping to the river in most cases. The exceptions are at Station 50+00 where no extension is required and Station 27+00 where the existing culvert will be connected to the new interior drain.

The existing 30-inch drain which discharges at Station 39+00 is undersized for a 10-year storm (drainage area is 300 acres). This size has been maintained for the extension, however, since an increase in size for the new drain would not increase the capacity of the existing 30-inch drain, and since excess runoff will flow without damage across the Manson Lab. parking area into the channel.

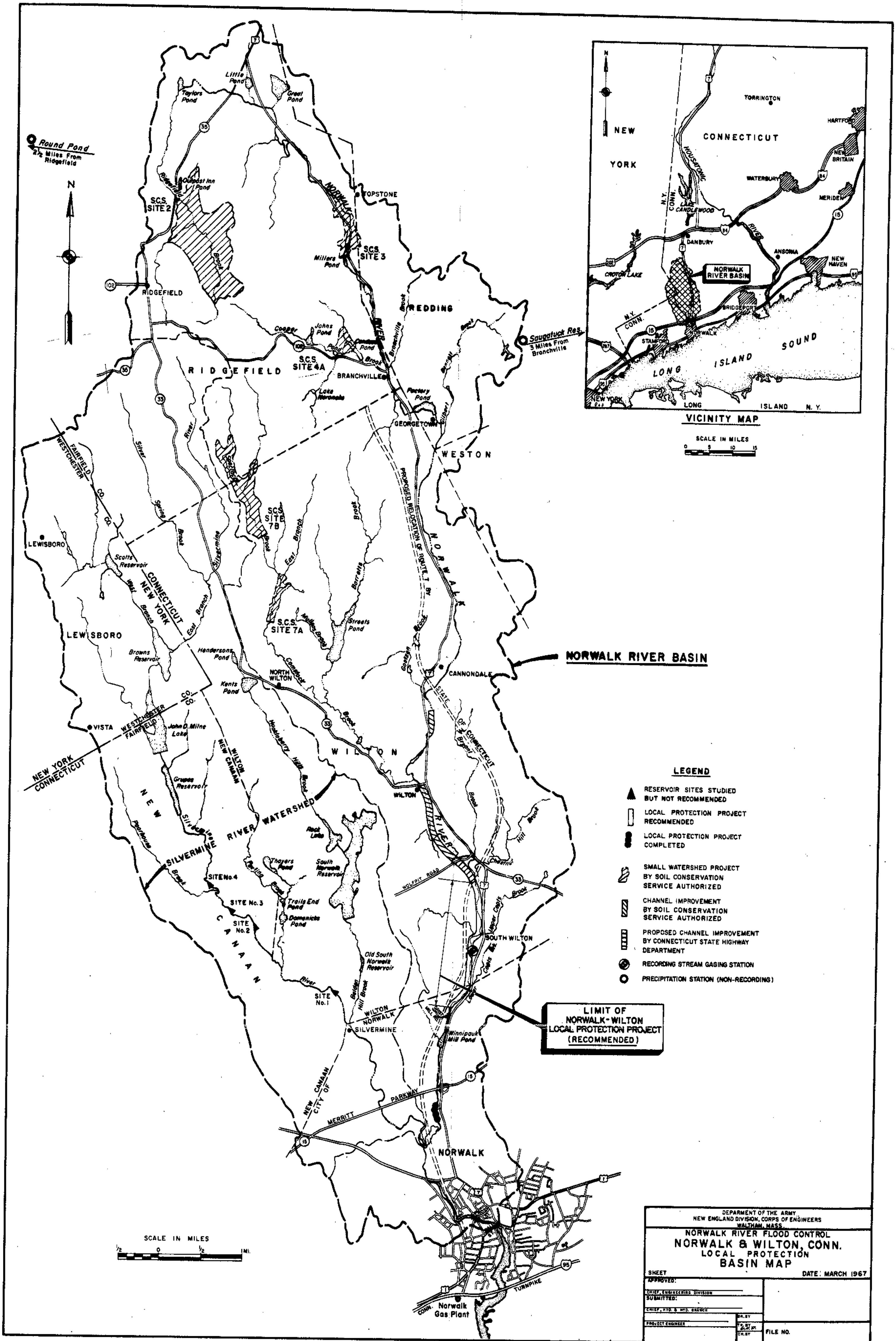
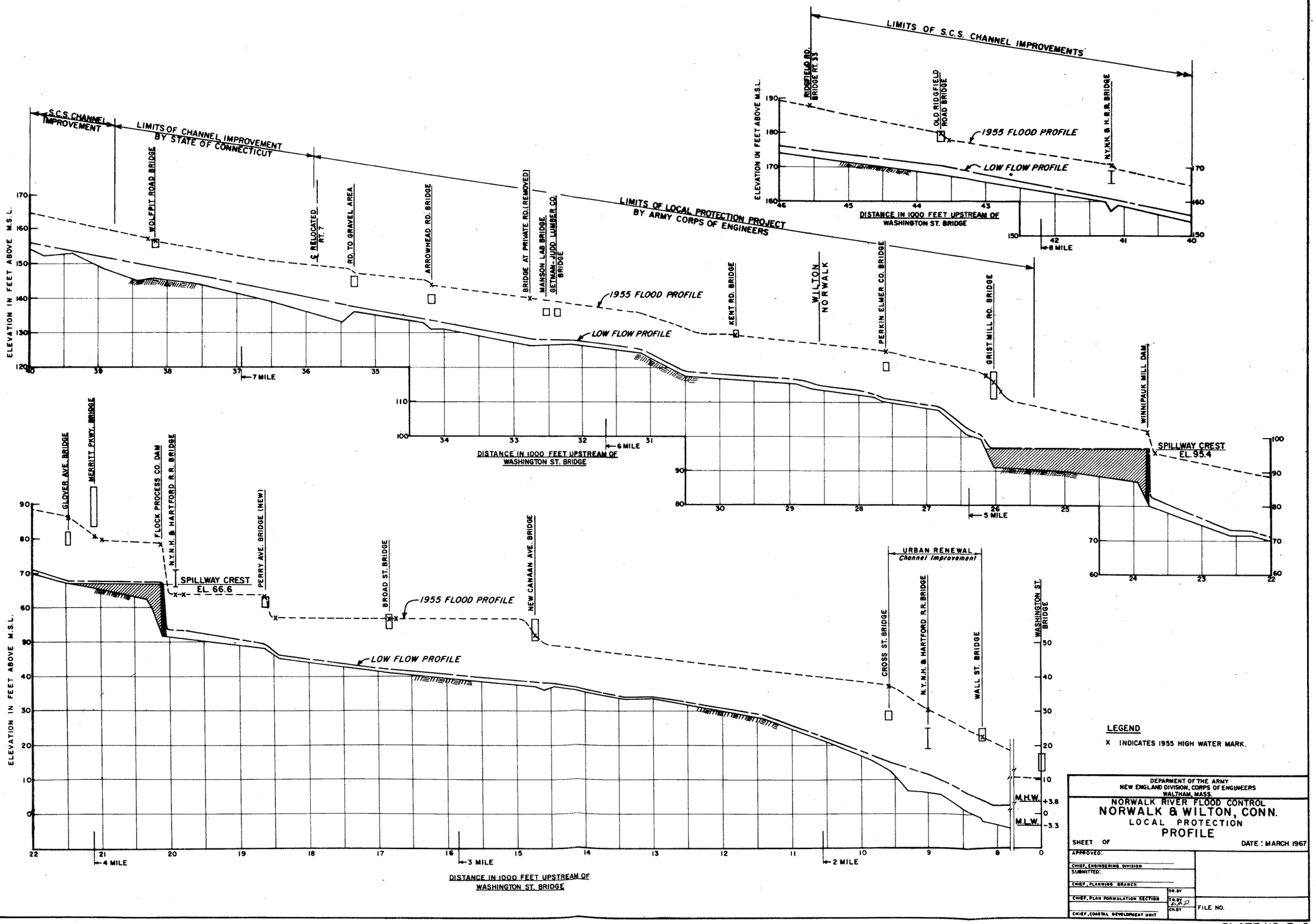

Round Pond
2½ Miles From Ridgefield
Little Pond
Taylors Pond
Great Pond
Outpost Inn Pond
S.C.S. SITE 2
TOPSTONE
NORWALK
S.C.S. SITE 3
Millers Pond
RIDGEFIELD
REDDING
Cooper
Johns Pond
Pond Brook
S.C.S. SITE 4A
BRANCHVILLE
Saugatuck Res.
3 Miles From Branchville
RIDGEFIELD
Lake Naraneka
Factory Pond
GEORGETOWN
WESTON
FAIRFIELD CO.
WESTCHESTER CO.
PROPOSED RELOCATION OF ROUTE 7 BY
S.C.S. SITE 7B
LEWISBORO
Scotts Reservoir
CONNECTICUT
NEW YORK
East Branch
S.C.S. SITE 7A
Streets Pond
NORWALK RIVER BASIN
LEWISBORO
Browns Reservoir
Hendersons Pond
NORTH WILTON
Kents Pond
CANNONDALE
STATE OF CONNECTICUT
VISTA
WESTCHESTER CO.
FAIRFIELD CO.
John D. Milne Lake
WILTON
NEW CANAAN
NEW YORK
CONNECTICUT
Grupes Reservoir
WILTON
SILVERMINE RIVER WATERSHED
Rock Lake
Thayers Pond
South Norwalk Reservoir
NEW CANAAN
SITE No. 4
SITE No. 3
SITE No. 2
Trails End Pond
Domenicks Pond
WOLFPIT ROAD
SOUTH WILTON
Old South Norwalk Reservoir
SITE No. 1
WILTON
NORWALK
SILVERMINE
Winnipauk Mill Pond
LIMIT OF NORWALK-WILTON LOCAL PROTECTION PROJECT (RECOMMENDED)
NEW CANAAN
CITY OF
MERRITT PARKWAY
NORWALK
Norwalk Gas Plant
TURNPIKE
CONN.
LEGEND
RESERVOIR SITES STUDIED BUT NOT RECOMMENDED
LOCAL PROTECTION PROJECT RECOMMENDED
LOCAL PROTECTION PROJECT COMPLETED
SMALL WATERSHED PROJECT BY SOIL CONSERVATION SERVICE AUTHORIZED
CHANNEL IMPROVEMENT BY SOIL CONSERVATION SERVICE AUTHORIZED
PROPOSED CHANNEL IMPROVEMENT BY CONNECTICUT STATE HIGHWAY DEPARTMENT
RECORDING STREAM GAGING STATION
PRECIPITATION STATION (NON-RECORDING)
SCALE IN MILES
½ 0 ½ 1 MI.
NEW YORK
CONNECTICUT
TORRINGTON
HARTFORD
NEW BRITAIN
WATERBURY
MERIDEN
LAKE CANDLEWOOD
DANBURY
ANSONIA
NEW HAVEN
CROTON LAKE
NORWALK RIVER BASIN
BRIDGEPORT
STAMFORD
NORWALK
LONG ISLAND SOUND
NEW YORK
LONG ISLAND N.Y.
VICINITY MAP
SCALE IN MILES
0 5 10 15
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.
NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
BASIN MAP
SHEET
DATE: MARCH 1967
APPROVED:
CHIEF, ENGINEERING DIVISION
SUBMITTED:
CHIEF, HYD. & HYD. BRANCH
PROJECT ENGINEER
FILE NO.

PLATE NO. B-1

CORPS OF ENGINEERS

U. S. ARMY



LEGEND

X INDICATES 1955 HIGH WATER MARK.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
PROFILE

SHEET OF

DATE : MARCH 1967

APPROVED:		
CHIEF, ENGINEERING DIVISION		
SUBMITTED:		
CHIEF, PLANNING BRANCH		
CHIEF, PLAN FORMULATION SECTION	DR. BY	
	T.S. BY	FILE NO.
CHIEF, COASTAL DEVELOPMENT UNIT	CH. BY	

PLATE NO. B-2

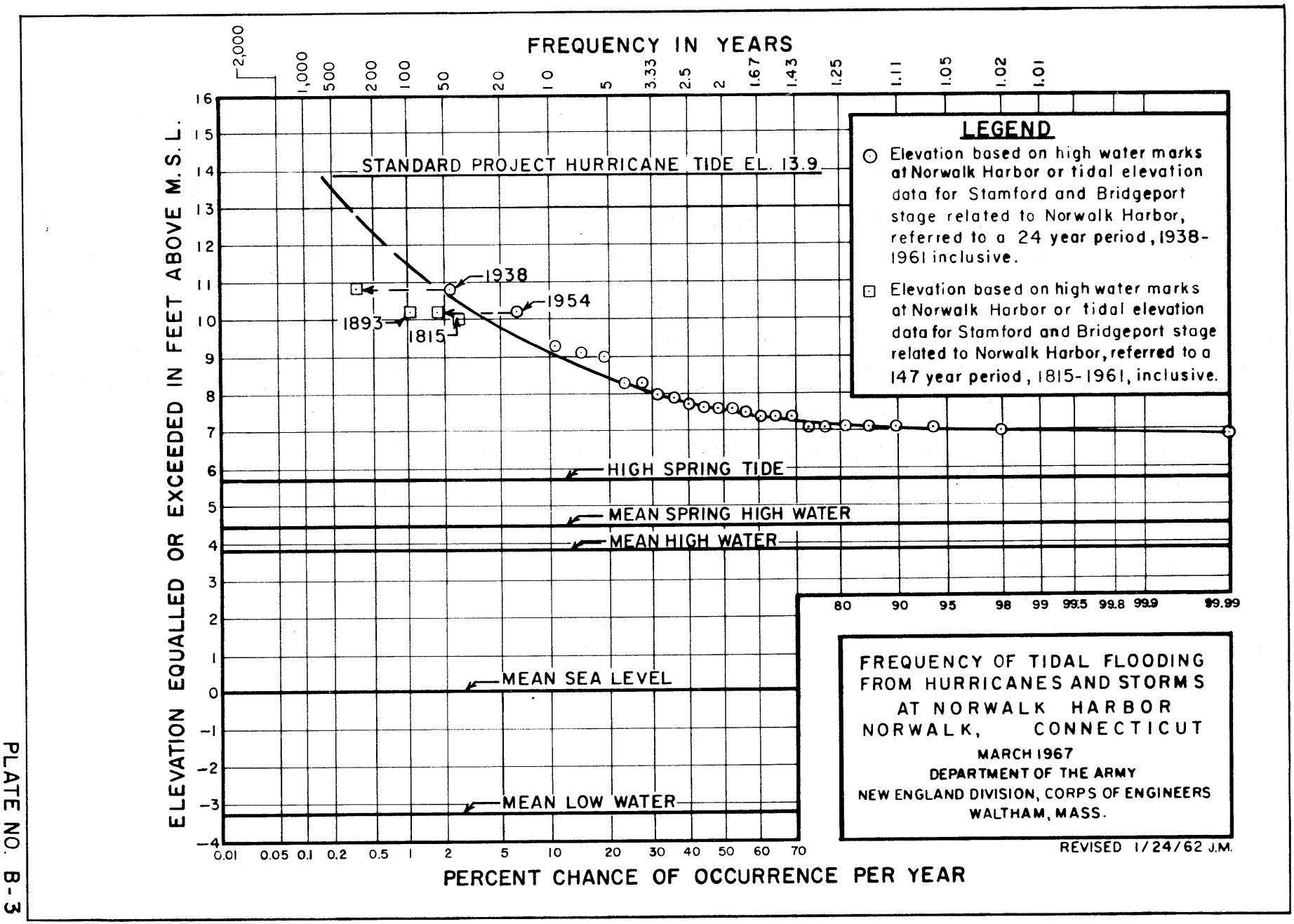
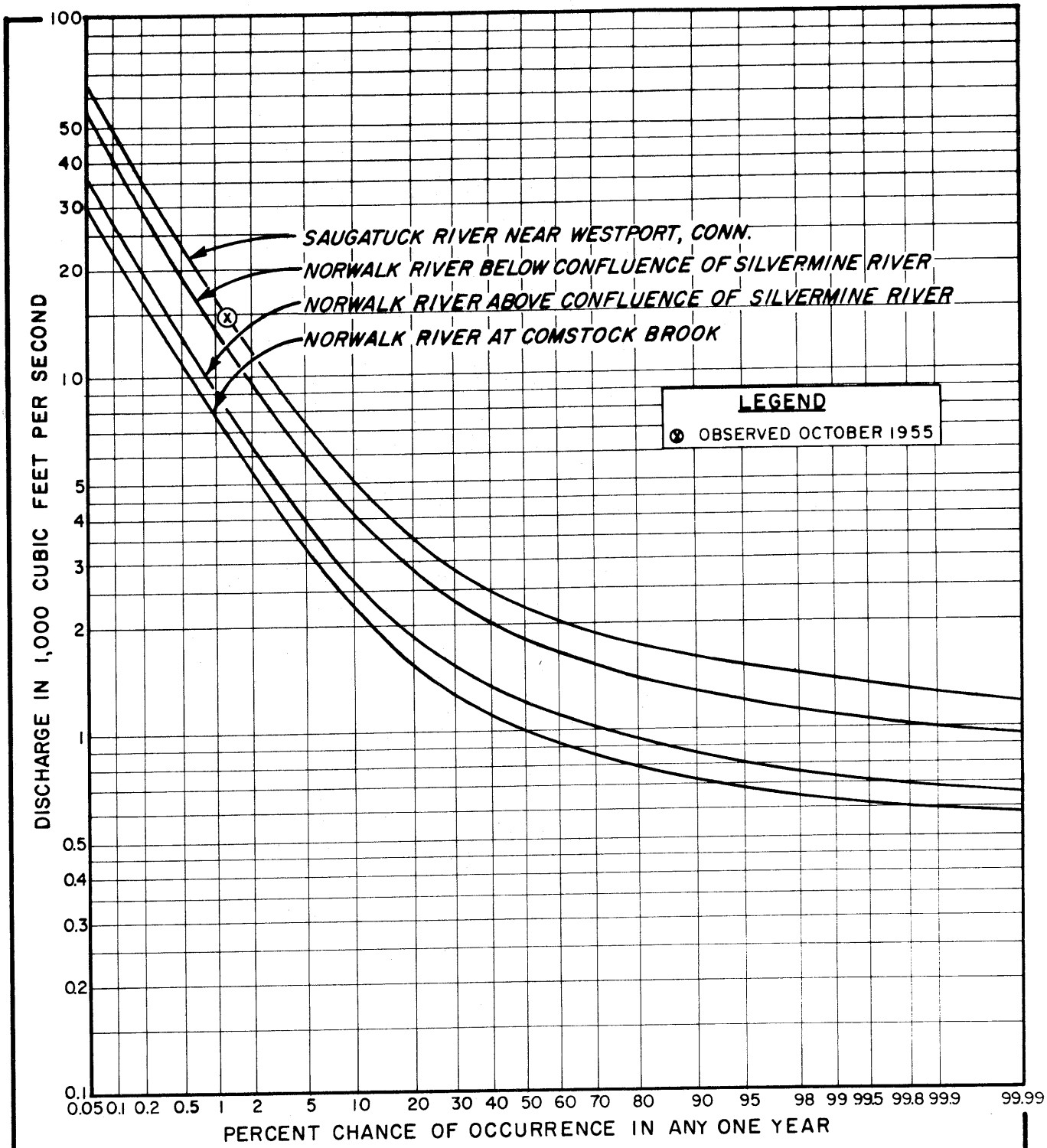

FREQUENCY IN YEARS
2,000
1,000
500
200
100
50
20
10
5
3.33
2.5
2
1.67
1.43
1.25
1.11
1.05
1.02
1.01
ELEVATION EQUALLED OR EXCEEDED IN FEET ABOVE M.S.L.
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
STANDARD PROJECT HURRICANE TIDE EL. 13.9
1938
1954
1893
1815
HIGH SPRING TIDE
MEAN SPRING HIGH WATER
MEAN HIGH WATER
MEAN SEA LEVEL
MEAN LOW WATER
0.01
0.05
0.1
0.2
0.5
1
2
5
10
20
30
40
50
60
70
80
90
95
98
99
99.5
99.8
99.9
99.99
PERCENT CHANCE OF OCCURRENCE PER YEAR
LEGEND
Elevation based on high water marks at Norwalk Harbor or tidal elevation data for Stamford and Bridgeport stage related to Norwalk Harbor, referred to a 24 year period, 1938-1961 inclusive.
Elevation based on high water marks at Norwalk Harbor or tidal elevation data for Stamford and Bridgeport stage related to Norwalk Harbor, referred to a 147 year period, 1815-1961, inclusive.
FREQUENCY OF TIDAL FLOODING FROM HURRICANES AND STORMS
AT NORWALK HARBOR
NORWALK, CONNECTICUT
MARCH 1967
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.
REVISED 1/24/62 J.M.

PLATE NO. B-3



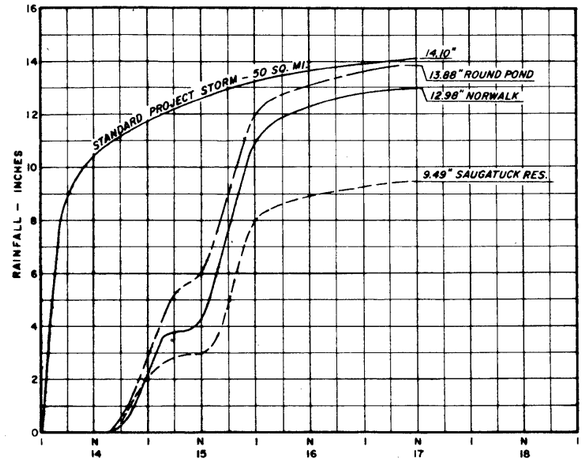
NORWALK RIVER FLOOD CONTROL

DISCHARGE-FREQUENCY CURVES

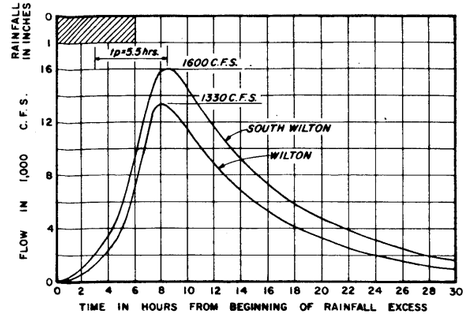
MARCH 1967

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

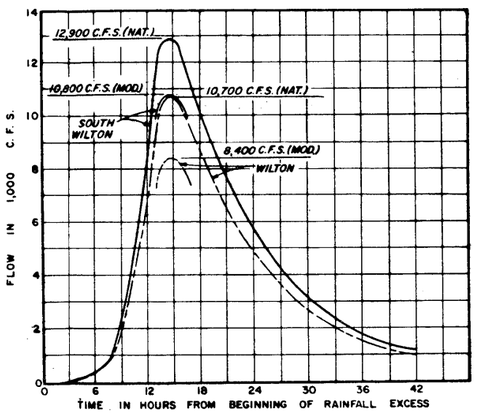
PLATE B-4



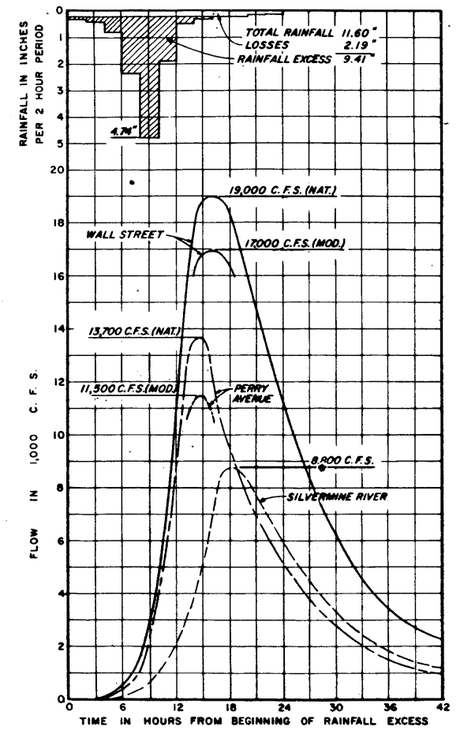
MASS. RAINFALL



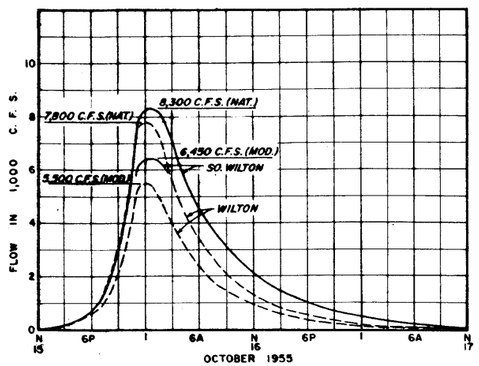
6 - HOUR UNIT HYDROGRAPH



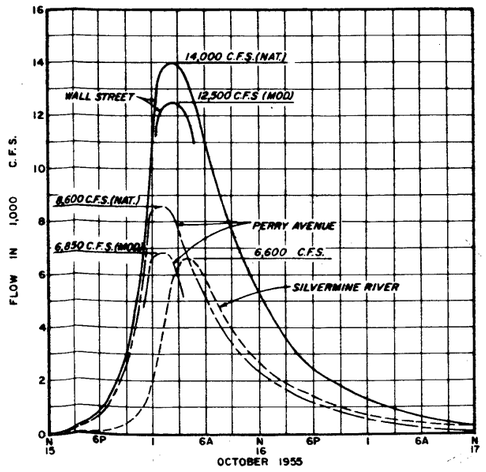
STANDARD PROJECT FLOOD
AT WILTON & SO. WILTON, CONNECTICUT



STANDARD PROJECT FLOOD
AT PERRY AVENUE & WALL STREET
NORWALK, CONNECTICUT



OCTOBER 1955 FLOOD
AT WILTON & SO. WILTON, CONNECTICUT



OCTOBER 1955 FLOOD
AT PERRY AVENUE & WALL STREET
NORWALK, CONNECTICUT

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION - CORPS OF ENGINEERS
WALTHAM, MASS.

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
HYDROLOGIC DATA
OCTOBER, 1955 AND S.P.F.
NORWALK RIVER CONNECTICUT

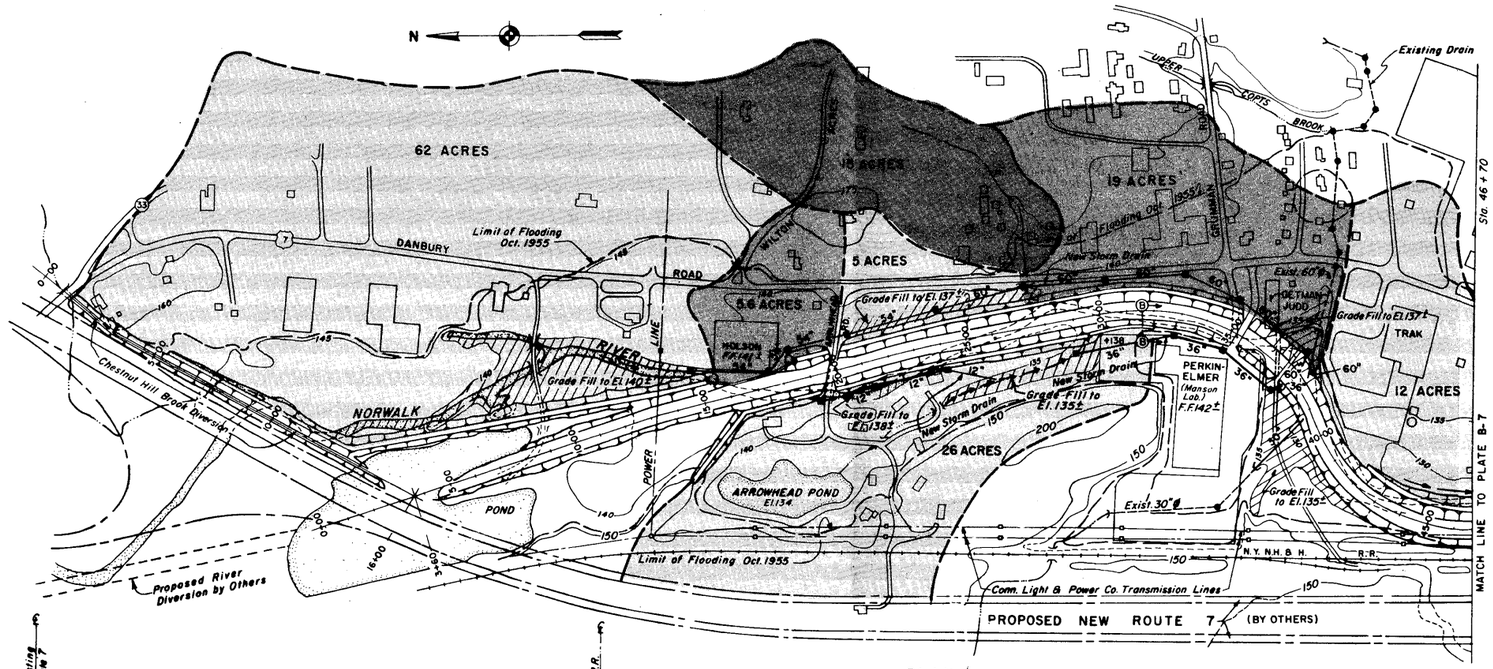
APPROVED:
CHIEF, ENGINEERING DIVISION
SUBMITTED:
CHIEF, PLANNING BRANCH
CHIEF, PLAN FORMULATION SECTION
CHIEF, FLOOD CONTROL STUDY UNIT

DATE: MARCH 1967

PLATE B-8

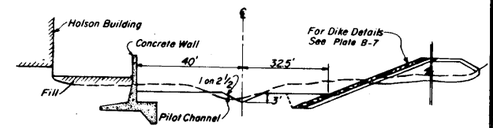
CORPS OF ENGINEERS

U. S. ARMY



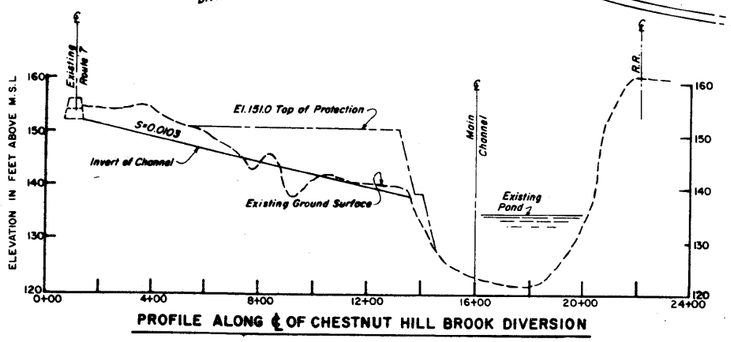
PLAN

SCALE: 1" = 200'

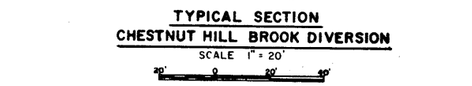


SECTION AT STA. 17+00

SCALE: 1" = 20'



PROFILE ALONG ℄ OF CHESTNUT HILL BROOK DIVERSION

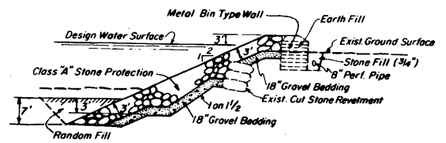


NOTE. For Dike Details See Plate B-7

TYPICAL SECTION

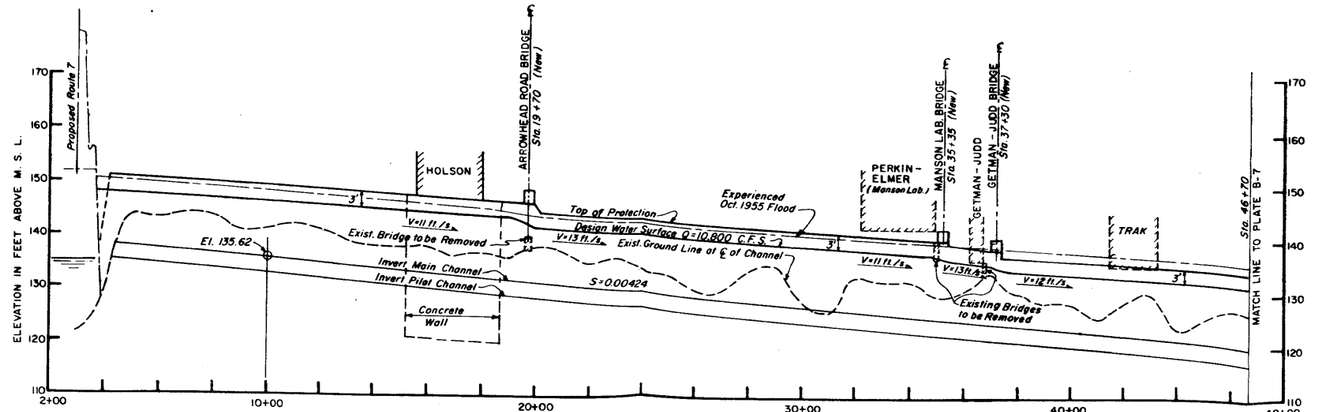
CHESTNUT HILL BROOK DIVERSION

SCALE 1" = 20'



SECTION B-B

SCALE: 1" = 10'



PROFILE ALONG ℄ OF CHANNEL

LEGEND FOR INTERIOR DRAINAGE

- Limit of Interior Drainage Subareas
- Proposed Storm Drains
- New Manholes
- Existing Manholes
- Existing Drains
- Proposed Drainage Ditch

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION - CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY N.M.B.	CK. BY P.J.M.

SUBMITTED:

RECOMMENDED:

CHIEF, PLAN FORMULATION SEC.

APPROVAL RECOMMENDED

CHIEF, PLANNING BRANCH

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
PLAN, PROFILE & INTERIOR DRAINAGE
PLAN-1

NORWALK RIVER, CONNECTICUT

APPROVED:

DATE MARCH 1967

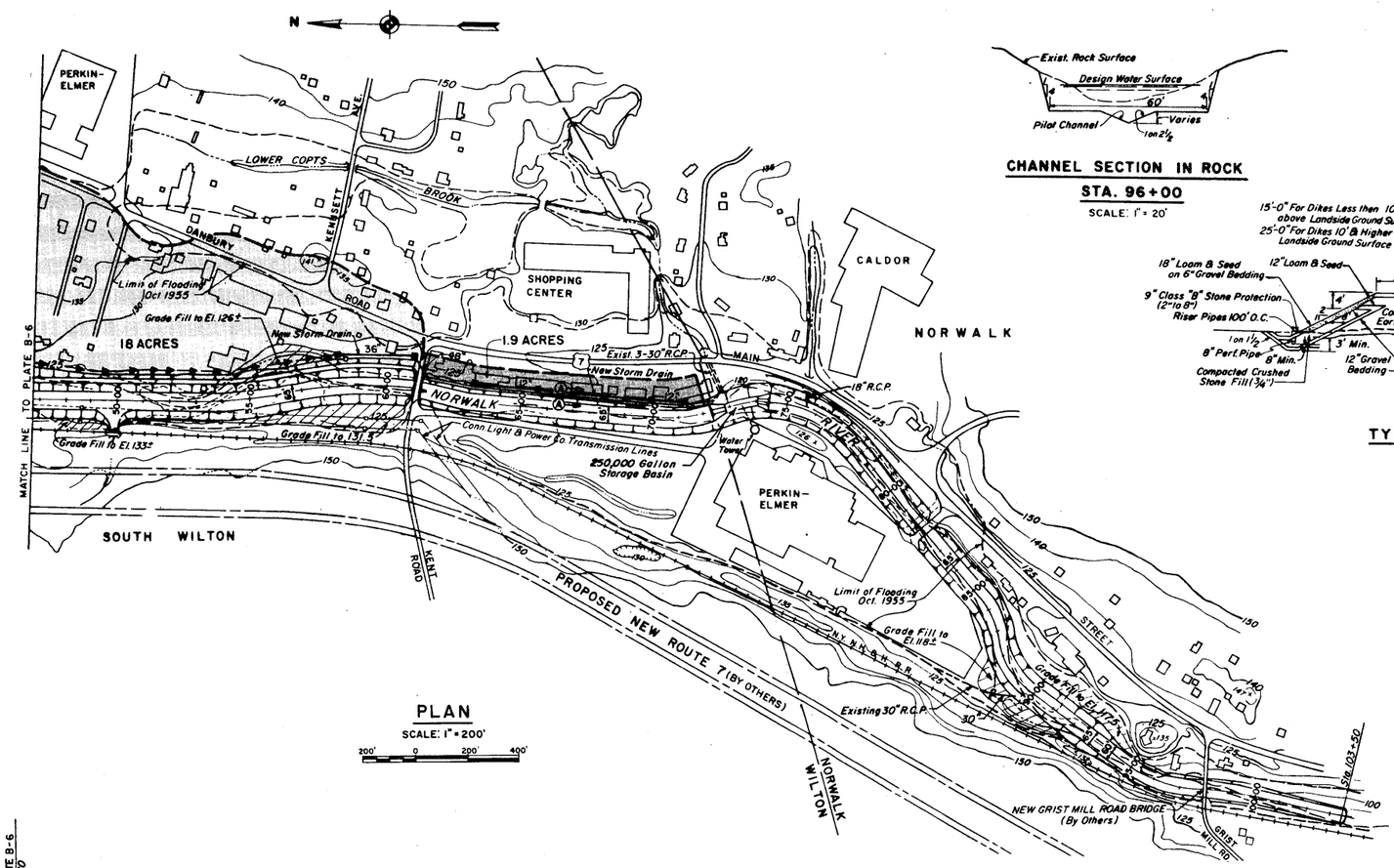
CHIEF, ENGINEERING DIVISION

TO ACCOMPANY REPORT
DATED: 15, MARCH 1967

SCALE: AS SHOWN

DRAWING NUMBER

PLATE B-6



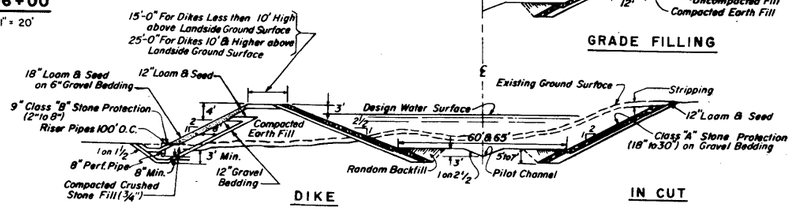
PLAN

SCALE: 1" = 200'

CHANNEL SECTION IN ROCK

STA. 96+00

SCALE: 1" = 20'



TYPICAL CHANNEL SECTION

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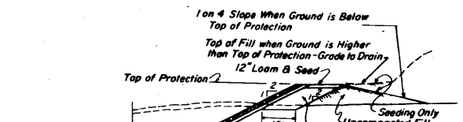
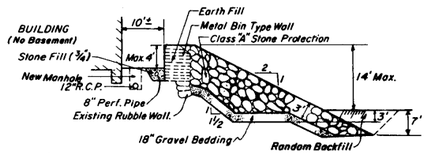
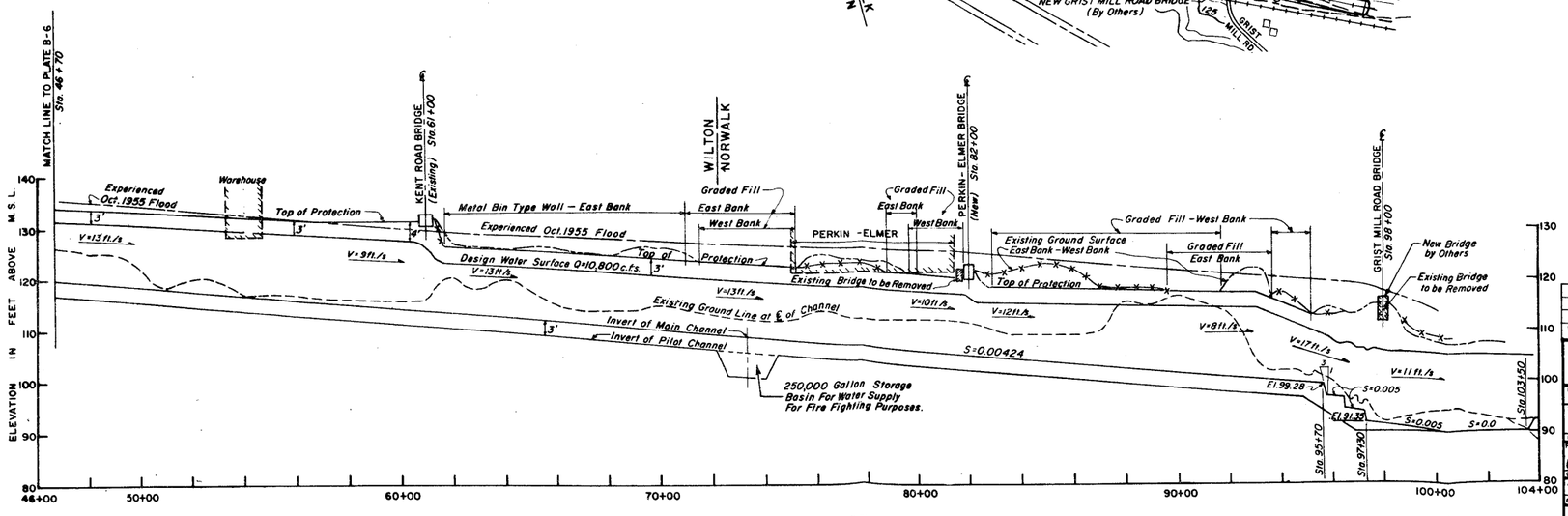




SECTION A - A

SCALE: 1" = 10'



PROFILE ALONG ℄ OF CHANNEL

NOTE:

For Interior Drainage Legend See PLATE B-6

NOTE:

Thickness and Sizes of Class "A" Stone Protection Conforms to Requirements of "DRAFT REPORT, CRITERION FOR GRADED STONE RIPRAP," H.Q., Department of the Army, O.C.E. 20 April 1966. All Stone Protection Materials will be Processed to Meet Size Requirements.

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION – CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY M.W.B	CK. BY

SUBMITTED:
PROJECT ENGINEER
REVIEWED
SURVEY PLAN FOR LOCATIONS APPROVAL RECOMMENDED
CHIEF, PLANNING BRANCH

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
PLAN, PROFILE & INTERIOR DRAINAGE
PLAN-2
NORWALK RIVER, CONNECTICUT

APPROVED
DATE MARCH 1967
CHIEF, ENGINEERING DIVISION

TO ACCOMPANY REPORT
DATED: 15, MARCH 1967

SCALE

DRAWING NUMBER

PLATE B-7

APPENDIX C

FLOOD LOSSES AND BENEFITS

APPENDIX C

FLOOD LOSSES AND BENEFITS

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TABLES

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APPENDIX C

FLOOD LOSSES AND BENEFITS

1. DAMAGE SURVEYS

A damage survey of the Norwalk River, made following the record flood of October 1955, was reviewed in recent months. The survey consisted largely of door-to-door interviews and inspections of the various residential, commercial, public and industrial properties in the flooded areas of Norwalk and Wilton. Information obtained included the extent of areas flooded, descriptions of properties, including economic and physical changes since the 1955 flood, the nature and amount of damages, depths of flooding, highwater references, and relationships between the 1955 flood level and other flood stages. Damage estimates and depths of flooding were generally furnished by property owners or tenants. Investigators prepared alternative estimates when, in their judgment, estimates of owners or tenants were unrealistic or unreliable. The investigators also made estimates if information was not available from owners or tenants. Sampling methods were used where similar-type properties were subject to the same depth of flooding. The review survey extended the coverage of the data from the Norwalk-Wilton line to the center of Wilton on the main river and also appraised the losses which might be expected on the Silvermine River in Norwalk, Wilton, and New Canaan. The review of previously-surveyed properties was made to determine the changes in business activities of the larger industrial plants which were included in the original survey, and to estimate damages to new properties in the flood area.

Sufficient data were obtained to derive recurring loss estimates for (1) the October 1955 flood stage, (2) a stage 3 feet higher, and (3) intermediate stages where marked changes in damage occur. The stage at which damage begins, referenced to the 1955 flood stage, was also determined.

2. LOSS CLASSIFICATION

Flood loss information was recorded by type of loss and by location. The types of losses included urban (residential, commercial, public), industrial, highway, railroad, and utility. Primary losses were evaluated including (1) physical losses such as damage to structures, machinery and stock, and the cost of clean-up and repairs, and (2) non-physical losses such as unrecoverable loss of business and wages, cost of temporary facilities and increased cost of operation. Losses resulting from physical damage and substantially all of the related non-physical losses were determined by direct inspection of flooded properties and evaluation by property

owners, field investigators, or both, for industrial, public, and commercial installations. For residential properties, when estimates of non-physical losses were not available from the owner, estimates were based on an established relationship between physical and non-physical losses for similar properties in the survey and similar areas. No evaluations were made of intangible damages including such items as loss of life, hazards to public health, and impairment of national security.

3. RECURRING LOSSES

Stage-damage data for individual properties were summarized by reaches with relatively uniform hydraulic characteristics throughout. Stage-damage curves, referenced to the peak elevations experienced in the record flood of 1955, were developed to reflect the magnitude of recurring losses at various stages of flooding above and below the experienced flood for each of the studied reaches on the Norwalk River. The recurring losses used in development of the stage-damage relationships reflect the economic and physical conditions existing in the basin in 1965. A recurrence of the stages of the 1955 flood would cause losses in Norwalk and Wilton estimated at $6,650,000 and $1,100,000, respectively, at 1966 price levels. Table C-1 lists recurring losses by location and type in the study area.

TABLE C-1
RECURRING OCTOBER 1955 FLOOD LOSSES
BY TYPES OF LOSSES

Type	Norwalk	Wilton	Along Silvermine River	Total Losses
Industrial	$6,030,000	$ 245,000	-	$6,275,000
Urban	585,000	800,000	$200,000	1,585,000
Highway	10,000	45,000	-	55,000
Utility	10,000	5,000	-	15,000
Railroad	15,000	5,000	-	20,000
TOTAL	$6,650,000	$1,100,000	$200,000	$7,950,000

4. ANNUAL LOSSES

Recurring losses in the studied reaches of the Norwalk River were converted to average annual losses to provide a basis for determining annual benefits to be used in economic evaluation. The stage-damage curve for each reach was correlated with a stage-frequency curve for the reach to produce damage-frequency curves from which annual losses were derived in accordance with standard Corps of Engineers practice. Plates C-1 and C-2 show the procedure used in converting recurring stage-damage data to a curve of damage-frequency for a typical reach of the Norwalk River. Average annual

losses for the studied reaches were found to be $360,000. Annual losses in the project area amount to $257,200 under present conditions.

5. FUTURE ANNUAL LOSSES

In addition to damages which would result to existing facilities from future floods, there will be damages to facilities to be built in the flood plain under future conditions. There are some 25 acres of land zoned for designed enterprise in lots of at least 5 acres in size in the area considered for protection. Based on a unit loss per acre established for the type of industry which Wilton zoning laws permit, future annual losses in the project area were estimated to be $40,000 for the 25 acres of land when occupied by permitted construction. At the current rate of growth in construction in the Wilton area, the entire 25 acres will be built over before the recommended project is completed.

6. BENEFITS

a. Tangible Benefits

Flood damage prevention benefits were derived from damage-frequency curves developed using standard Corps of Engineers procedures. The flood damage prevention benefits were derived as the difference in annual losses without protection and those losses remaining after construction of the recommended project. Annual benefits to the recommended project were derived with the project acting before the construction of five floodwater retarding structures by the Soil Conservation Service and amount to $216,500 under present conditions and $250,500 under conditions at time of project completion. Benefits were also derived considering the recommended project acting after the construction of the SCS plan and acting in a system with the SCS structures without priority. Benefits to the project acting after the construction of the SCS plan amount to $150,580 under present conditions and $174,000 under post-project conditions. Benefits to the project acting in a system with the SCS structures without priority amount to $168,400 under present conditions and $193,200 under post-project conditions. Without priority benefits assigned to each project are the total joint benefits apportioned to each project in the ratio of its effectiveness acting alone or first in the system. A summary of the benefits for the plans investigated is shown on Table C-2.

b. Intangible Benefits

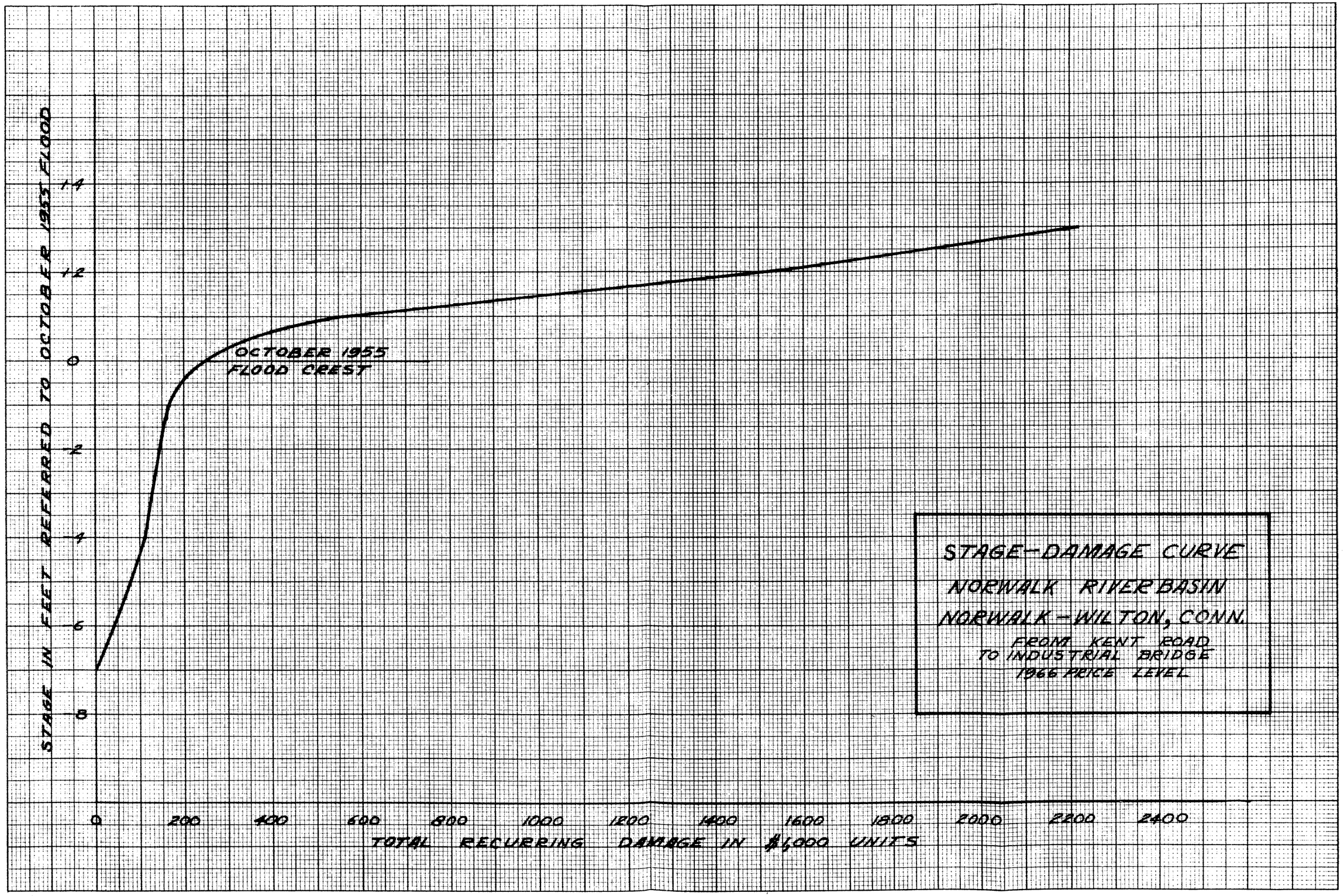
The project would also provide significant benefits which are not susceptible to monetary evaluation. The possible loss of life, the dangers of disease arising from polluted flood water and the feelings of insecurity and worry among area residents would be greatly reduced by construction of the project.

TABLE C-2

NORWALK-WILTON, CONNECTICUT
ANNUAL LOSSES AND BENEFITS
(1966 Price Level)

	Channel Design Flow - c.f.s.				
	6,400	8,300	10,800	12,900	14,300
Annual Loss	$297,200	$297,200	$297,200	$297,200	$297,200
SCS Plan First					
Annual loss after SCS plan	210,000	210,000	210,000	210,000	210,000
Annual benefit to SCS plan	87,200	87,200	87,200	87,200	87,200
Annual loss after SCS & Corps plan	41,000	39,000	36,000	29,200	22,300
Annual benefit to Corps plan	169,000	171,000	174,000	180,800	187,700
CORPS Plan First					
Annual loss after Corps plan	59,900	54,500	46,700	38,700	31,500
Annual benefit to Corps plan	237,300	242,700	250,500	258,500	265,700
Annual loss after SCS & Corps plan	41,000	39,000	36,000	29,200	22,300
Annual benefit to SCS plan	18,900	15,500	10,700	9,500	9,200
ANNUAL BENEFITS WITHOUT PRIORITY					
Total Joint Benefits	256,200	258,200	261,200	268,000	274,900
Corps Plan	188,200	190,200	193,200	200,000	206,900
SCS Plan	68,000	68,000	68,000	68,000	68,000

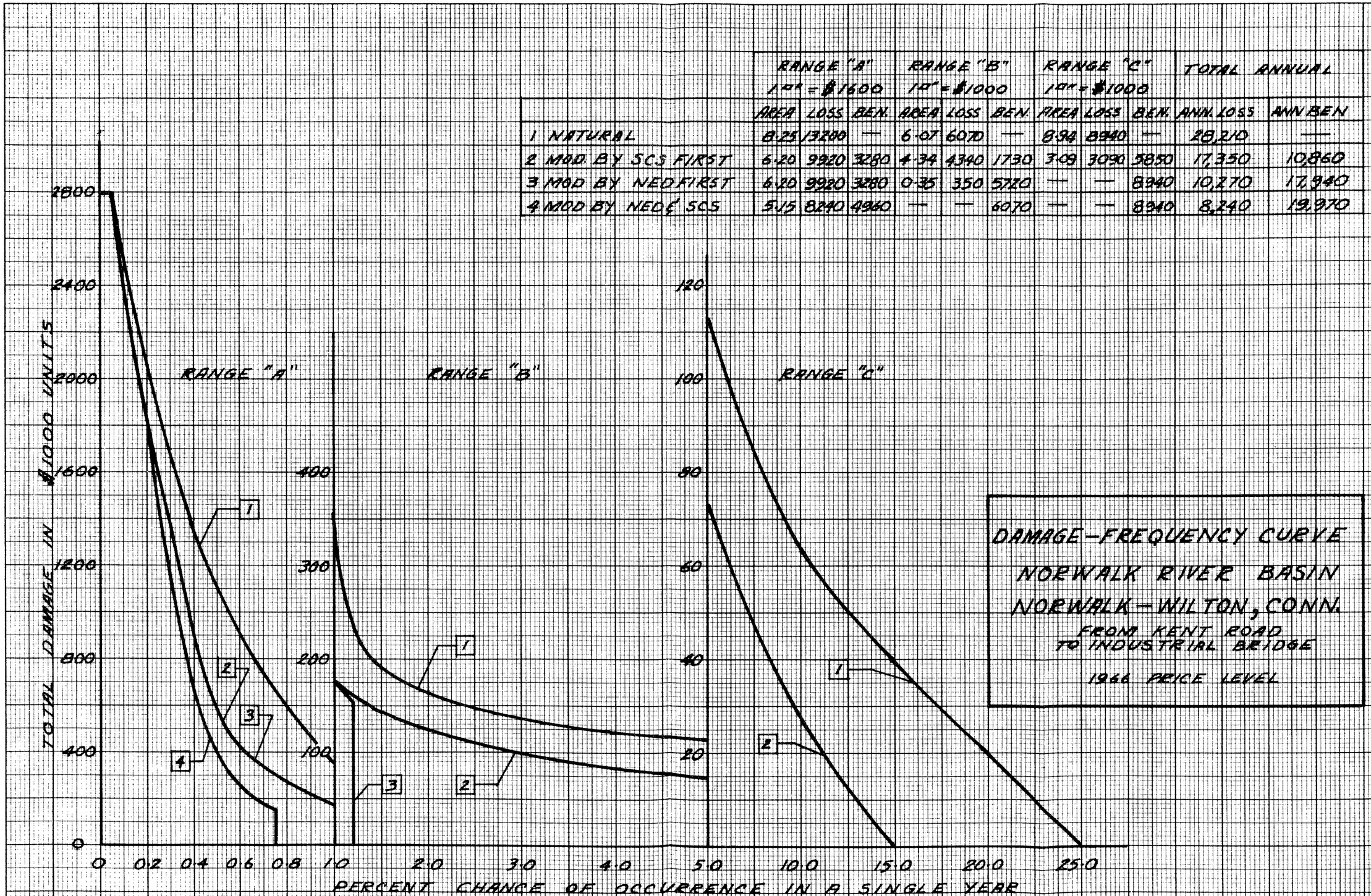
NOTE: Benefits cited lie solely within the local protection project area. Additional benefits in other reaches will accrue to SCS reservoir plan.



STAGE-DAMAGE CURVE
NORWALK RIVER BASIN
NORWALK-WILTON, CONN.
FROM KENT ROAD
TO INDUSTRIAL BRIDGE
1966 PRICE LEVEL

PLATE C-1

	RANGE "A" 1"=$1600			RANGE "B" 1"=$1000			RANGE "C" 1"=$1000			TOTAL ANNUAL	
	AREA	LOSS	BEN.	AREA	LOSS	BEN.	AREA	LOSS	BEN.	ANN. LOSS	ANN BEN
1 NATURAL	8.25	13200	—	6.07	6070	—	8.94	8940	—	28,210	—
2 MOD BY SCS FIRST	6.20	9920	3280	4.34	4340	1730	3.09	3090	5850	17,350	10,860
3 MOD BY NEO FIRST	6.20	9920	3280	0.35	350	5720	—	—	8940	10,270	17,940
4 MOD BY NEO & SCS	5.15	8240	4960	—	—	6070	—	—	8940	8,240	19,970



DAMAGE-FREQUENCY CURVE
NORWALK RIVER BASIN
NORWALK-WILTON, CONN.
FROM KENT ROAD
TO INDUSTRIAL BRIDGE
1966 PRICE LEVEL

APPENDIX D

FLOOD CONTROL PLANS

APPENDIX D

FLOOD CONTROL PLANS

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FLOOD CONTROL PLANS

1. GEOLOGY

a. Regional Geology and Topography. The Norwalk River drainage area is located on the southern coastal section of the western Connecticut Highlands. The area is of moderate relief and generally maturely dissected with a north-south drainage system consequent to the regional slope. Steep-sided, rock-controlled valley walls, thinly mantled by deposits of bony glacial till and wide valleys choked with glaciolacustrine deposits typify the valley cross section of the area. Narrow rock-controlled gorges of hard resistant rock occur at intervals along the stream profile and restrict its normal meandering course in areas of deep glacial lake deposits. The depth of the glaciolacustrine materials deposited in ice-dammed lakes were largely controlled by former discharge channels in the valley walls which were abandoned during glacial recession. These abandoned spillways varied over the length of the Norwalk River from elevation 600* at the headwaters to elevation 90 at the mouth. The lake deposits now appear as step-like terraces along the valley profile separated by areas of steeper gradient where the stream crosses resistant rock ridges.

Bedrock of Paleozoic Age is exposed along the valley walls and in resistant spines protruding through the valley deposits. The principal rock varieties of schists and gneiss have been extensively intruded by granitic bodies. This intrusion has produced a massive, blocky rock structure which in most areas displays little structural weakness along the planes of foliation.

b. Surficial Geology. The Norwalk River in the project area flows for a distance of approximately 10,000 feet over a series of glaciolacustrine deposits. The upper elevations of these deposits vary from elevation 160 feet at the upstream end to elevation 140 feet 1,000 feet upstream of the downstream limits of the project. The stream meandering has been controlled by a bedrock spine projecting from the west wall of the valley midway of the project and by a narrow rock gorge at the downstream limits. The nature of the valley deposits are exposed in several draglined gravel pits and typically consists of bony sand and gravel having a thickness estimated as being in excess of 30 feet. These gravelly deposits are overlain in much of the area by variable depths of silty sands containing scattered local surface concentrations of boulders. Large portions of the present stream alignment are encroached on by land fills of industrial and small business developments. These fills are comprised of random materials consisting to a large degree of rock blocks removed during land development adjacent to the valley walls.

*All elevations are referred to mean sea level datum.

Subsurface water levels in the area approximate the stream gradient profile in the area of free draining granular deposits and would be expected to vary from elevation 140 feet at the upstream project limits to elevation 110 at the downstream limits. Minor variations will occur in areas where the free drainage is blocked by artificial structures.

Bedrock is exposed in the project area at two primary locations. The first location is in a rock spine having a 50-foot high, recently-excavated face of fresh, hard, and massive gneissic granite located midway of the project. The rock structure has a N-S vertical joint set and N60°W, 75° dipping joint set which is closely spaced at the surface becoming wider with depth. The second location is in the downstream limits of the project where granitic gneiss is exposed for a distance of approximately 1,000 feet. Structural weaknesses in this rock are controlled by N20°E strike of foliation with a 60° dip to the east and a vertical joint set of approximately N40°W.

2. PROJECT DESCRIPTION

a. General. The recommended local protection project would be aligned generally along the Norwalk River in Norwalk and Wilton, Connecticut and would extend from below Grist Mill Road bridge in Norwalk to a channel under the proposed Route 7 river crossing in Wilton, a total length of 10,000 feet. An interior drainage system would be included.

The project would provide protection against the standard project flood reduced by the water retarding structures approved for construction by the Soil Conservation Service of the Department of Agriculture. Project plans and details are shown on Plates D-1 and D-2.

b. Channel Work. Channel improvement would, in general, be trapezoidal in cross section. Starting at Station 103+50 (550 feet downstream of Grist Mill Road bridge) and extending upstream about 950 feet (to Station 94+00) the channel excavation would be in rock, with a bottom width of 60 feet. From Station 93+00 to the upper limit of the improvement, the width would be 65 feet and excavation would be in earth. Proposed side slopes for channel excavation include: 4 on 1 in rock, 1 on 2 in earth without dikes, and 1 on 2½ where dikes are required.

To concentrate low flows for fish, a V-shaped pilot channel three feet deep with 1 on 2½ side slopes would be provided along the channel centerline from Grist Mill Road bridge to the upper limits of the project.

c. Bank protection. Generally, the bank will be grade-filled or in cut downstream of Kent Road bridge except on the east bank at a commercial area where a metal bin-type wall would be provided. Upstream from the bridge, the west bank would be grade-filled or in cut for approximately 2,900 feet to the vicinity of Manson Lab. Upstream of the laboratory, bank protection would consist of a metal bin-type wall, about 250 feet in length, which would tie into a 1,700-foot long dike extending northerly to about 300 feet past Arrowhead Road and then veering northwesterly away from the channel to tie into high ground north of Arrowhead Pond. The east bank protection upstream of the Kent Road bridge would consist of a dike extending 1,900 feet to high ground followed by cut or grade fill for about 700 feet and a dike continuing 1,700 feet to the Holson Plant. A concrete wall, 350 feet in length, would protect the plant and tie into a dike which would extend about 1,300 feet to the upper limits of the improvement. A diked channel adjacent to the proposed Route 7 embankment would direct the discharge from Chestnut Hill Brook into the channel.

The dikes, in general, would consist of compacted earth fill from channel excavation; have a top width of 15 feet for dikes less than 10 feet high above landside ground surface and 25 feet for dikes over 10 feet high; and have side slopes of 1 on 2½ on channel side and 1 on 2 on land side. Channel facing would be Class "A" protection stone conforming to requirements of "Draft Report, Criterion for Graded Stone Riprap," Headquarters, Department of the Army, Chief of Engineers, dated 20 April 1966. All protection stone would be processed to meet size requirements. For cost estimating purposes for this report, 18-inch protection stone was considered throughout the project except that 30-inch protection stone was used on the outside of curves below and at Kent Road bridge, and 24-inch protection stone for the outside of curves in the vicinity of one of the Perkin-Elmer Facilities (formerly the Manson Laboratories). A 12-inch gravel bedding would be provided under all protection stone except for protection stone at metal bin-type walls, where 18 inches of gravel bedding would be provided. The top and land side of the dike would be topsoiled and seeded. A toe drain with perforated pipe and risers would be provided in dikes 5 feet and higher above landside ground surface.

Excavated materials which are unsuitable for use in the dike or are in excess of the dike requirement would be spoiled in the areas noted on the plans as "graded fill areas."

d. Retaining walls and bridges. A concrete wall would be provided to protect the Holson Plant, which is situated close to the channel on the east bank. A low, metal bin retaining wall

would be constructed on the east bank immediately downstream of Kent Road bridge and on the west bank at the former Manson Laboratories, where buildings preclude dikes. As part of the project, four new bridges would be built replacing existing ones at the Perkin-Elmer plant, the Getman-Judd plant (for access to their storage yard) the former Manson Laboratories and at Arrowhead Road. Replacement of the Grist Mill Road bridge at the lower end of the project would be done by others as part of the new Route 7 highway.

e. Power transmission line. The alignment of the Connecticut Light and Power Company transmission line within the limits of the proposed channel would be relocated outside of the project work area.

f. Intake structure for water tower. The structure would be reconstructed in its present location with a lower intake invert, and a basin in the bottom of the proposed channel having a storage capacity of approximately 250,000 gallons for water supply for fire-fighting purposes, equal to the existing facility.

g. Interior drainage. Construction of the recommended plan of protection would disrupt interior drainage that now discharges into the Norwalk River. Interceptor drains would be provided on the land side of dikes and metal bin-type walls to conduct to the channel by gravity all interior drainage and seepage through the dikes and walls occurring during flood periods. The interceptor drain lines would be constructed of reinforced concrete pipe varying in size from 54 to 60 inches in diameter for the east dike and of 36-inch size for the west dike and a 12-inch size for the bin-type wall below Kent Road bridge.

Interior drainage for the area immediately upstream of Kent Road bridge and adjacent to the east dike would be conducted to below the bridge through 36- and 48-inch concrete conduits.

Reinforced concrete pipe extensions would be provided for existing drains and culverts which discharge into the river except at Station 27+00 where the culvert would be connected to the new interior drainage system.

h. Channel flows studied. Five flows were investigated for two alternative channel alignments: 6,400 cfs - the maximum flood of record modified by upstream structures proposed by the Soil Conservation Service; 8,300 cfs - the maximum flood of record unmodified; 10,800 cfs - the standard project flood modified by the Soil Conservation Service plan; 12,900 cfs - the standard project flood unmodified; and 14,300 cfs - a flow approximately

one-third greater than the standard project flood modified by the Soil Conservation Service plan. Widths of 60 and 65 feet and various channel bottom gradients were also studied.

3. FOUNDATIONS AND EMBANKMENTS

a. Site Examination and Exploration. Site reconnaissance together with pertinent data obtained from local construction projects, geological maps, and a limited number of foundation explorations provided the supporting subsurface data considered necessary for the survey report.

Foundation explorations were made on two alignments and consisted of four foundation test borings and eight test pits. All foundation test borings were continuously sampled in overburden and cored a minimum penetration of 15 feet in rock. Test pits were made with powered trenching equipment and bulk samples were taken for testing. The record of foundation exploration is shown on Plate D-3.

b. Foundations. The proposed channel alignment is close to the present river channel except upstream of station 30+00, where it is economic to provide a relatively straight channel alignment by cutting off the present river channel.

Rock is exposed along both river banks downstream of station 92+00. Upstream of station 92+00, the natural foundation, in general, consists of sandy gravel overlain by a 2- to 5-foot layer of medium to fine silty sand. The natural foundation in some areas is overlain by man-made fills built along both river banks for the purpose of grading shopping center and parking areas. These fills are generally thin and consist of overburden materials obtained from local natural deposits.

The natural sandy gravel is highly pervious, contains a large amount of cobbles and less than 10 per cent silt. The overlying, medium to fine, silty sand contains 10 to 40 percent silt and is less pervious than the sandy gravel.

c. Excavation. (1) Earth. The required channel excavation is generally 5 to 15 feet deep. Before any deep excavation is made, the entire channel area will be first stripped of about 2 feet of topsoil for the purpose of avoiding the mixing of organic surface soils with underlying sand and gravel materials which are to be used in the construction of the compacted earth-fill dikes.

By providing gravity drainage features and by conducting the excavation in a manner which will provide maximum gravity drainage, it is anticipated that only the lower few feet of channel excavation will require underwater excavation.

(2) Rock. Channel excavation between station 92+00 and station 103+50 will be primarily in granite gneiss rock. Maximum depth of excavation will be about 17 feet and will be carefully controlled because of the proximity of the excavation to the railroad and buildings.

d. Dikes. The dike heights are less than 15 feet above either the proposed channel bottom or the landside ground surface. Due to the highly pervious nature of the foundation, wherever the top of the dike is more than 10 feet above the landside ground surface, the width of the dike is increased to provide a longer seepage path.

Foundation and embankment seepage will be controlled by a compacted crushed stone fill section which will extend 3 to 8 feet below ground surface along the landside toe of the dike. The crushed stone fill below ground surface will top the sandy gravel deposit which underlies the less pervious sandy silt; in general, the deeper penetrations are needed to provide required invert elevation for gravitational drainage of the perforated metal pipe toe drain.

e. Concrete T-Walls and Metal Bin Walls. The concrete T-wall will be founded 10 feet below ground surface on natural sandy gravel foundation having ample shearing strength and bearing capacity. The wall stem will rise less than 10 feet above landside finish grade.

The metal bin walls are less than 4 feet high above the landside ground surface and do not require any special provisions other than the drainage features which are provided on the landside toe as shown on Plates D-1 and D-2.

4. AVAILABILITY OF CONSTRUCTION MATERIALS

a. Earth Fill Materials. Earth fill for construction of the structures will be obtained from required excavations. If needed, additional fill materials can be obtained by widening the channel at the upper limits of the project from station 5+00 to station 15+00.

b. Gravel Bedding. Gravel bedding material will be obtained by selection of sandy gravel material from required excavations. If additional quantities are needed, commercial gravel sources are present at a distance of 10 to 25 miles from the site.

c. Stone Protection and Crushed Stone Fill. Crushed stone for fill and riprap for stone protection is available from commercial quarries within 40 miles of the project. These quarries produce principally from a disbase basalt which will provide processed durable stone of adequate shape and size to meet the criteria specified in "Draft Report Criteria for Graded Stone Riprap" and to meet all other design requirements.

d. Concrete Aggregates. An estimated quantity of 1,200 c.y. of concrete will be required. Aggregate investigations made in conjunction with other flood control projects in the area have determined that satisfactory materials can be obtained from commercial sources within a 25-mile haul distance.

5. REAL ESTATE

a. Character of the taking. The land taking along the west side of the improvement, beginning 550 feet downstream of Grist Mill Road bridge and extending upstream to Kent Road bridge, would include: industrial land, a portion of a paved parking area, landscaped lawn, and a portion of a paved access road, all of which is the property of a large research and development plant. Above Kent Road bridge, the taking would include the Connecticut Light and Power Company transmission line right-of-way, industrial land, a portion of a lumber storage yard, the rear portions of three homesites and a portion of a gravel company operation.

Along the east bank, beginning below Grist Mill Road bridge and extending upstream to Kent Road bridge, the taking would traverse five residential properties, a two-car garage, a commercial property, an improved industrial site, and land along the rear of a commercial shopping area. Above Kent Road bridge, the taking would include, in upstream order: a small guest house, two residential units, a small portion of a lumber storage yard and building, a residential unit, potentially developable residential and industrial land, an active sand and gravel operation, and a developed homesite including an old barn.

No costs are included for filled land adjacent to the improvement because its increase in value is considered to offset any damages.

b. Evaluation. A careful and thorough search of the records of both Wilton and Norwalk was made to obtain sales data. Knowledge of the real estate market, obtained from this survey and analysis, forms the basis for estimating the real estate costs for this project. In addition, local assessors and well-informed appraisers were interviewed to secure data and value estimates.

c. Severance damages. Severance damages are predicated on project proximity to structures and improvements, distortion of plottage of residential and industrial sites, and loss or difficulty of access.

d. Administrative costs. Administrative costs include survey and mapping of tract maps, title search, appraisal services, negotiation and closing processes, and possible condemnation procedures.

e. Contingencies. A contingency allowance of approximately 10% is considered reasonable to provide for possible appreciation of property values from the time of this report to the acquisition date and also for possible adjustments or refinements of the taking lines or hidden ownerships which may develop.

f. Summary. A total of about 62 acres and 7 improvements are required for the project of which 8.8 acres are water. The estimated costs for lands and improvements total $1,220,000, of which $380,000 would be the cost to the city of Norwalk and $840,000 the cost to the town of Wilton. Table D-1 summarizes the real estate costs.

It is recommended that real estate interests be acquired under easements in lieu of fee, although easement values will equal fee values. Sound real estate practice indicates that severance damages will be reduced under easements as access to remainders will be left with underlying fee ownerships.

TABLE D-1

SUMMARY OF REAL ESTATE COSTS

Land		
8.00 acres	industrial land @ $50,000 p/a=	$ 400,000
1.08 acres	commercial land @ $45,000 p/a=	48,600
14.32 acres	limited industrial land @ $20,000 p/a=	286,400
5.30 acres	residential land @ $8,000 p/a=	42,400
16.32 acres	sand and gravel @ $5,000 p/a=	81,600
8.83 acres	water	0
8.15 acres	fill areas	0
62.00 acres		$ 859,000
Improvements		38,000
Severance Damages		165,000
Administrative Costs		47,000
Contingencies		111,000
	TOTAL	$1,220,000

6. COST ESTIMATE

a. Basis of estimate. U. S. Geological Survey maps to a scale of 1:24,000 with 10-foot contours, and aerial photogrammetric maps to a scale of 1"=200 feet with 5-foot contours were used in the study. Foundation conditions were determined by field reconnaissance and foundation explorations. Quantities of the principal construction items were estimated on the basis of a preliminary design which would provide safe and adequate structures. Hydrologic and hydraulic criteria adopted for the design of dikes, flood walls, interior drainage, and channel improvement are discussed in Appendix B. Benefits attributable to the plans are discussed in Appendix C.

Unit prices are based on average bid prices, adjusted to 1966 price levels, for similar projects in the area.

b. Contingencies, engineering, and overhead. To cover contingencies, construction and relocation costs have been increased 20 percent. Costs of engineering, design, supervision, and administration are estimated lump sums based on knowledge of the project areas and experience on similar projects.

c. Apportionment of costs. In accordance with current policy, local interests will be required to pay for all lands, damages, and relocations, and to operate and maintain the project after completion.

d. First costs. A detailed breakdown of first costs for the recommended project is shown in Table D-2.

TABLE D-2

FIRST COST - RECOMMENDED LOCAL PROTECTION PROJECT
(1966 Price Level)

Item	NORWALK Estimated Amount	WILTON Estimated Amount	PROJECT Estimated Amount
Lands and Damages			
Lands and Improvements	$282,000	$ 610,000	
Severance and Administration	64,000	154,000	
Contingencies	34,000	76,000	
Total	$380,000	$ 840,000	$1,220,000
Relocations			
Perkin-Elmer Bridge	$ 57,000	$ 0	
Perkin-Elmer Road	0	6,000	
Perkin-Elmer Water Intake	2,000	0	
Getman-Judd Bridge	0	38,000	
Perkin-Elmer Bridge (Formerly Manson Lab.)	0	80,000	
Arrowhead Road Bridge	0	71,000	
Conn. Light & Power Co. Transmission Line	0	10,000	
Contingencies	12,000	41,000	
Sub-Total	71,000	246,000	
Engineering and Design	8,000	26,000	
Supervision and Administration	6,000	23,000	
Total	$ 85,000	$ 295,000	$ 380,000
TOTAL LANDS, DAMAGES AND RELOCATIONS	$465,000	$1,135,000	$1,600,000

TABLE D-2 (Cont'd)

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount	Total
CONSTRUCTION					
Channels and Canals					
Site Preparation	42	Acre	$ 300.00	$ 12,600	
Stream Control	1	Job	L.S.	5,000	
Excavation					
Stripping	122,000	C.Y.	1.00	122,000	
Common	222,000	C.Y.	1.00	222,000	
Rock	16,300	C.Y.	6.00	97,800	
Sub-Total				$ 459,400	
Contingencies				90,600	$ 550,000
Dikes & Flood Walls					
Dikes					
Compacted Earth Fill	107,000	C.Y.	0.40	$ 42,800	
Compacted Crushed Stone (3/4")	23,500	C.Y.	10.00	235,000	
9"Crushed Stone (2" to 8")	5,200	C.Y.	10.00	52,000	
Gravel Bedding	42,400	C.Y.	0.75	31,800	
Rock-Borrow	49,200	C.Y.	9.00	442,800	
18" Protection Stone-Place	50,000	C.Y.	1.50	75,000	
24" Protection Stone-Place	8,000	C.Y.	1.50	12,000	
30" Protection Stone-Place	10,000	C.Y.	1.50	15,000	
Protection Stone-Control Testing	1	Job	L.S.	40,000	
Random Backfill	29,000	C.Y.	0.20	5,800	
Uncompacted Fill	40,500	C.Y.	0.20	8,100	
Topsoil and Seeding	28,000	S.Y.	0.60	16,800	
Seeding Only	23,500	S.Y.	0.20	4,700	
8" ACCMP	2,800	L.F.	3.00	8,400	
12" ACCMP	4,000	L.F.	3.50	14,000	
15" ACCMP	3,400	L.F.	4.50	15,300	

TABLE D-2 (Cont'd)

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount	Total
Dikes & Flood Walls (Cont'd)					
Flood Walls					
Stream Control	1	Job	L.S.	$ 5,000	
Structure Excavation	3,500	C.Y.	2.00	7,000	
Reinforced Concrete	1,200	C.Y.	80.00	96,000	
Metal Bin Wall	10,400	S.F.	5.00	52,000	
Sub-Total				$1,179,500	
Contingencies				240,500	$1,420,000
Interior Drainage					
12" R.C.P.	1,520	L.F.	9.00	$ 13,680	
36" R.C.P.	1,080	L.F.	33.00	35,640	
48" R.C.P.	100	L.F.	35.00	3,500	
54" R.C.P.	1,010	L.F.	53.00	53,530	
60" R.C.P.	1,550	L.F.	60.00	93,000	
Manhole - 12" Pipe	8	Each	400.00	3,200	
Manhole - 36" Pipe	6	Each	650.00	3,900	
Manhole - 54" Pipe	4	Each	900.00	3,600	
Manhole - 60" Pipe	6	Each	1,100.00	6,600	
18"R.C.P. Pipe Extension	50	L.F.	6.00	300	
30"R.C.P. Pipe Extension	500	L.F.	15.00	7,500	
60"R.C.P. Pipe Extension	200	L.F.	30.00	6,000	
Headwall - 12" Pipe	1	Each	400.00	400	
Headwall - 18" Pipe	1	Each	450.00	450	
Headwall - 30" Pipe	2	Each	500.00	1,000	
Headwall - 36" Pipe	2	Each	550.00	1,100	
Headwall - 60" Pipe	2	Each	800.00	1,600	
Headwall - 3-30" Pipe	1	Each	1,000.00	1,000	
Sub-Total				$ 236,000	
Contingencies				44,000	$ 280,000

TABLE D-2 (Cont'd)

Item	Estimated Quantity	Unit	Unit Price	Estimated Amount	Total
Miscellaneous Items					
Guard Rail	620	L.F.	$ 5.00	$ 3,100	
Structure Removal	5	Each	1,000.00	5,000	
Sub-Total				8,100	
Contingencies				1,900	$ 10,000
Sub-Total					$2,260,000
Engineering and Design					240,000
Supervision and Administration					200,000
TOTAL CONSTRUCTION COST					$2,700,000
TOTAL PROJECT FIRST COST					$4,300,000

(Pre-authorization costs of $70,000 not included.)

e. Annual charges. The estimate of Federal annual charges is based on interest at 3-1/8 percent on the Federal investment plus the amount required to amortize the investment over the assumed 100-year life of the project. The investment equals the Federal first cost since no interest charge accrues during the estimated construction period of one year. Non-Federal interest and amortization charges were computed in a similar manner at the same interest rate. Non-Federal charges also include amounts for maintenance of the project. No allowance is made for tax loss on lands removed from taxation since the amount of such loss will be more than offset by the increase in value of the protected properties. The derivation of annual charges is summarized in Table D-3.

TABLE D-3

SUMMARY OF FIRST COSTS AND ANNUAL CHARGES

	First Cost (thousands)	Annual Charges		
		Interest & Amortization	Maintenance	Total
Federal	$2,700	$88,500	-	$88,500
Non-Federal				
Norwalk	465	15,300	700	16,000
Wilton	1,135	37,200	3,300	40,500
Sub total	$1,600	$52,500	$4,000	$56,500
Total	$4,300	$141,000	$4,000	$145,000

7. OTHER PROJECTS STUDIED

a. General. The Norwalk River has been studied from Georgetown through Norwalk with particular attention to those areas which suffered damages in the flood of October 1955. All potential sites of flood control reservoirs in the basin, other than those selected by the Soil Conservation Service, were considered but none found, by preliminary analysis, to be economically feasible at this time. Studies considering local protective works at problem areas along the Norwalk River revealed that the only economically justified projects at this time are located between Grist Mill Road bridge and the new proposed Route 7 river crossing in Wilton. Projects studied but not recommended are described briefly in the following paragraphs.

b. Reservoirs. Four dam sites located on the Silvermine River were selected for preliminary investigation. The value of land lying in the reservoir areas is comparable to the value of most residential land in Fairfield county, one of the most prosperous parts of the nation. The location of this county, providing easy and rapid access to the vocational, professional, educational, and cultural opportunities of New York City, is favorable for local industrial research and development facilities and bedroom communities for higher-paid ranks of business and professional personnel of New York City. The cost of lands and developments required to be taken for reservoir lands in the basin precludes the economic justification of projects at any of the considered reservoir sites at this time.

c. Local protection.

(1) Alternative alignments. Two plans alternative to the recommended plan were considered. Each would improve the same reach of waterway as the recommended project and would be similar to that plan except for the alignment upstream of the Kent Road bridge where the alternative alignments follow alongside the railroad embankment rather than along the course of the

Norwalk River as does the recommended plan. The two alternatives differ form each other only in the upstream section of east bank dike alignment. In one plan, the dike would pass through the area of two ponds now used for swimming and, in the other, would veer easterly, away from the channel in the vicinity of Arrowhead Road and continue generally northerly upstream extending along the land side of the ponds, thus preserving them for the existing, or itensified, recreational use. This dike would continue as the Chestnut Hill brook diversion dike in each alternative.

Each alternative would require construction of three new bridges and a pumping station with ponding area.

The alternative plans, although economically justified were rejected because local interests expressed strong preference for the recommended alignment. In addition the recommended plan has a slightly lower cost. Table D-4 presents a summary of first costs, annual charges and benefits, and the benefit-cost ratio for each alternative and for the recommended plan.

TABLE D-4

SUMMARY OF COSTS AND BENEFITS
RECOMMENDED AND ALTERNATIVE PLANS
(1966 Price Level)

	Recommended Plan (Design flow 10,800 cfs - Amounts in thousands)	Alternative Plans	
		Preserving Ponds	Filling in Ponds
First Costs			
Federal	$2,700	$3,100	$3,100
Non-Federal	1,600	1,660	1,630
Total First Costs	$4,300	$4,760	$4,730
Annual Charges			
Federal	$88.5	$101.6	$101.6
Non-Federal	56.5	63.8 (1)	62.8 (1)
Total Annual Charges	$145.0	$165.4	$164.4
Annual Benefits	193.2	193.2	193.2
Benefit-Cost Ratio	1.33	1.16	1.17

(1) Includes $5,000 for maintenance and operation and $4,400 for interim replacements.

(2) Wilton local protection. A channel improvement project was studied for the Norwalk River in the reach between the new Route 7 river crossing at the upstream limit of the recommended project, and the center of Wilton, a distance of approximately 7,600 feet. Channel widths of 60 feet and 120 feet were considered. An existing railroad bridge would require lengthening for either channel width.

Flood protection was also considered for the center of Wilton. The work, extending about 1,900 feet downstream from the Route 33 bridge, would consist of concrete retaining walls and earth dikes.

Studies of the work described in the preceding paragraphs determined that the flood damages preventable by construction of either of the considered improvements are insufficient to justify the cost of such work at this time.

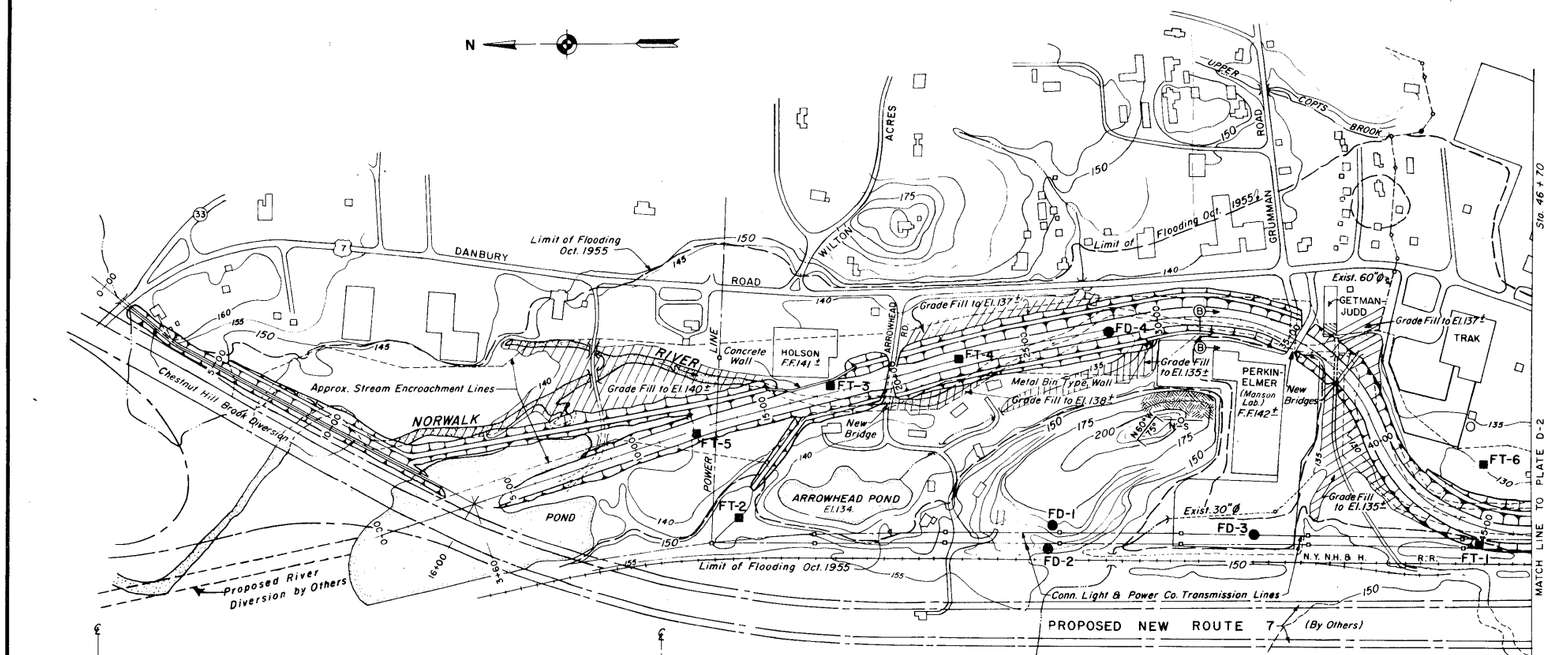
(3) Norwalk local protection. Consideration was given to the possibility of providing local protection works along the Norwalk River in the city of Norwalk. The 2,000 - foot stretch of flood-prone area studied extends from a point about 1,350 feet upstream of Cross Street bridge downstream to the New Haven railroad bridge. The area is occupied by a large laminated plastic product plant; a large, fur processing plant; and commercial and residential buildings. Protection could be provided by floodwalls, dikes, and pumping facilities, but the cost of such work is not economically justified at this time.

The channel downstream of the railroad bridge has been improved as a part of an Urban Renewal project.

d. Existing project modification. Preliminary consideration was given to raising the dike at the existing project for local protection in the vicinity of Perry Street, in Norwalk, to insure containment of the standard project flood as modified by the upstream work plan of the Soil Conservation Service. Although desirable, this improvement is not economically feasible at this time.

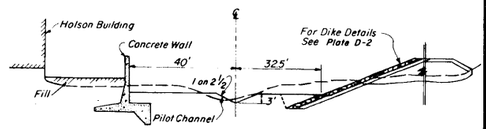
CORPS OF ENGINEERS

U. S. ARMY



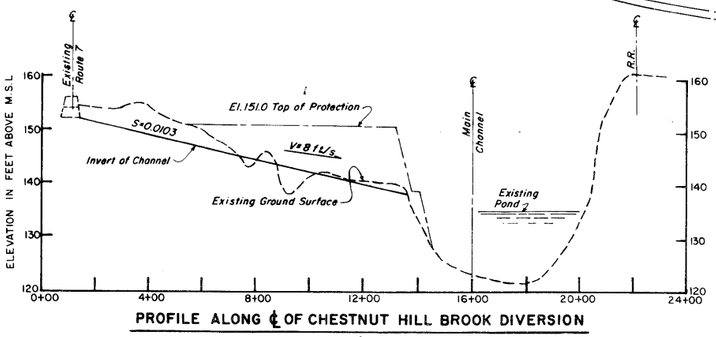
PLAN

SCALE: 1" = 200'

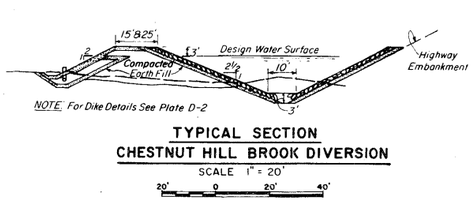


SECTION AT STA. 17+00

SCALE: 1" = 20'

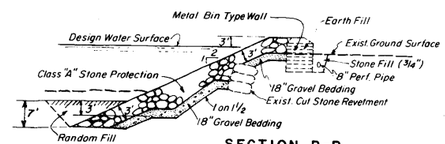


PROFILE ALONG ℄ OF CHESTNUT HILL BROOK DIVERSION



TYPICAL SECTION
CHESTNUT HILL BROOK DIVERSION

SCALE 1" = 20'



SECTION B-B

SCALE 1" = 10'

NOTE:

For Typical Channel Details See Plate D-2

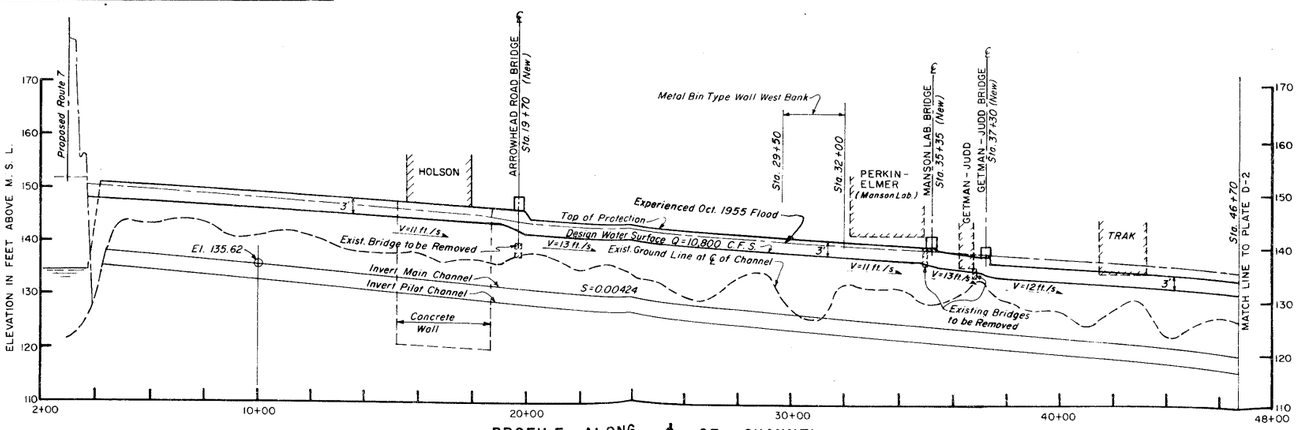
For Record of Foundation Explorations See Plate D-3

Transmission line within new channel to be relocated.

LEGEND FOR GEOLOGICAL SYMBOLS

- FD-1 Foundation Test Boring
- FT-1 Foundation Test Pit
- Bedrock Outcrop
- N 20° E, 70° NW — Strike and Dip of Foliation
- N 60° W, 0° — Strike and Dip of Joint Planes
- N-S — Strike of Vertical Joints

Borings FD-1, FD-2, FD-3, and Foundation Test Trench FT-2 made for Alternate Alignment



PROFILE ALONG ℄ OF CHANNEL

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION – CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY	CK. BY
	M.W.B.	P.J.M.

SUBMITTED

PROJECT ENGINEER

REVIEWED

CHIEF, ENGINEERING DIVISION

APPROVAL RECOMMENDED

CHIEF, PLANNING BRANCH

APPROVED

CHIEF ENGINEERING DIVISION

DATE MARCH 1967

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
DETAIL PLAN I

NORWALK RIVER CONNECTICUT

SCALE

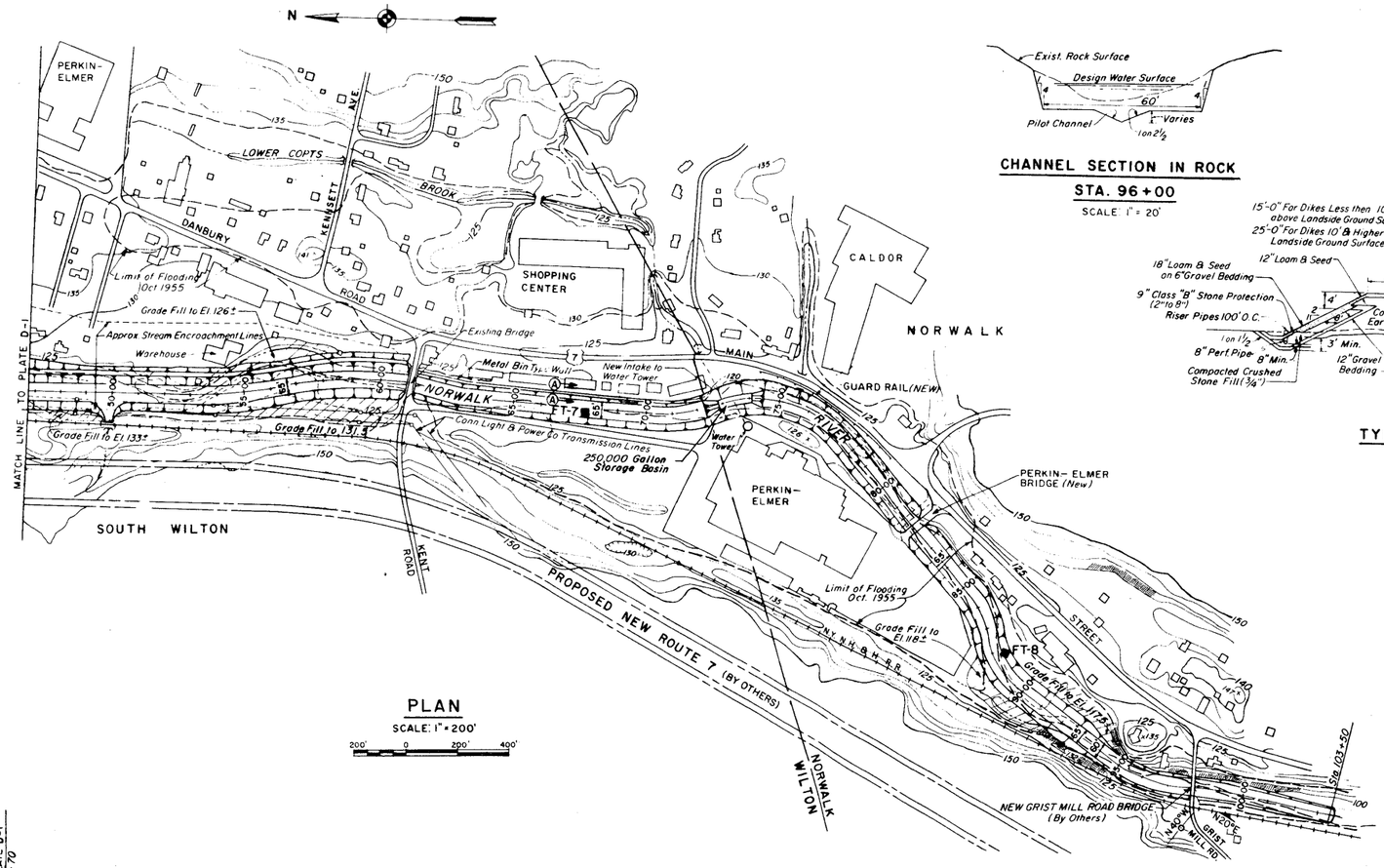
DRAWING NUMBER

TO ACCOMPANY REPORT
DATED: 15, MARCH 1967

PLATE D-1

CORPS OF ENGINEERS

U. S. ARMY



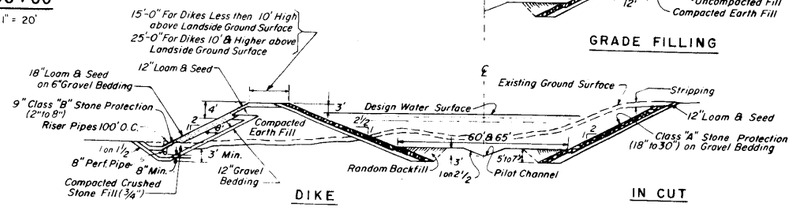
PLAN

SCALE: 1" = 200'

200' 0 200' 400'

CHANNEL SECTION IN ROCK STA. 96+00

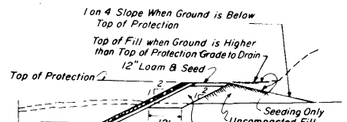
SCALE: 1" = 20'



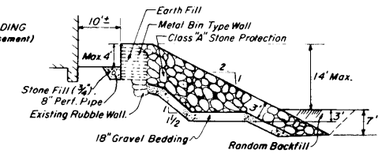
TYPICAL CHANNEL SECTION

SCALE: 1" = 20'

20' 0 20' 40'

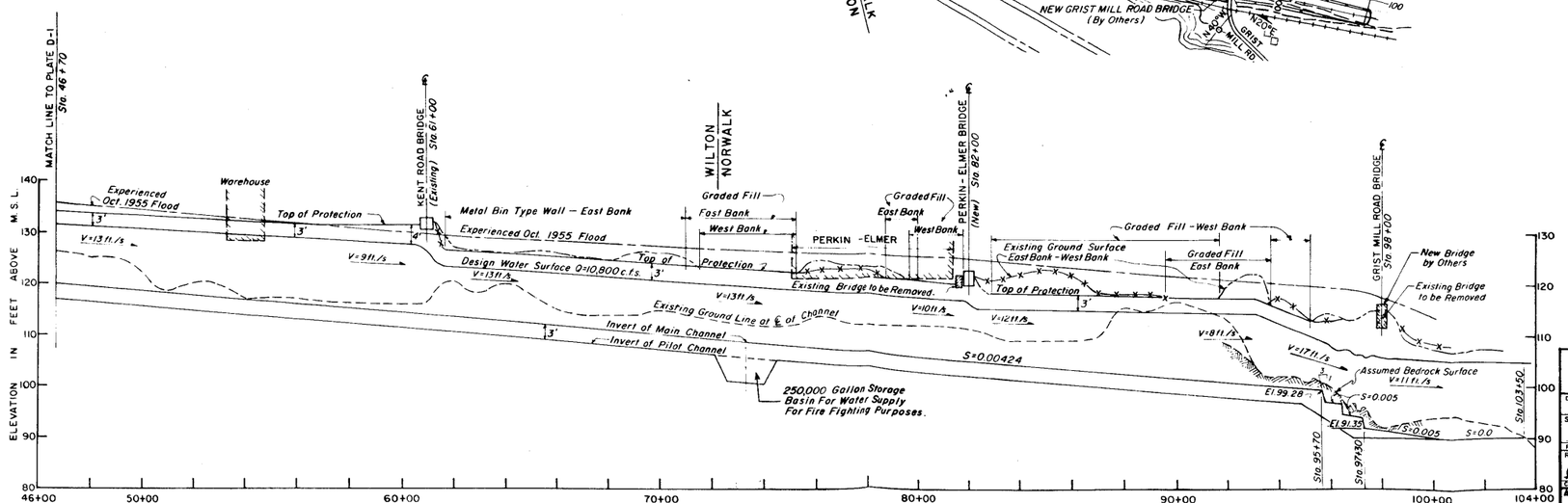


GRADE FILLING



SECTION A-A

SCALE: 1" = 10'



PROFILE ALONG ℄ OF CHANNEL

NOTE:

Thickness and Sizes of Class "A" Stone Protection Conforms to Requirements of "DRAFT REPORT, CRITERION FOR GRADED STONE RIPRAP," H.Q., Department of the Army, O.C.E. 20 April 1966. All Stone Protection Materials will be Processed to Meet Size Requirements.

Legend for Geological Symbols shown on Plate D-1

For Record of Foundation Explorations See Plate D-3

Transmission line within new channel to be relocated

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION – CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY	CK. BY
	MWB	P.J.M.

SUBMITTED:
PROJECT ENGINEER
REVIEWED:
CHIEF, PLANNING BRANCH
APPROVAL RECOMMENDED
CHIEF, ENGINEERING DIVISION
APPROVED.
DATE MARCH 1967

NORWALK RIVER FLOOD CONTROL
NORWALK & WILTON, CONN.
LOCAL PROTECTION
DETAIL PLAN 2
NORWALK RIVER CONNECTICUT

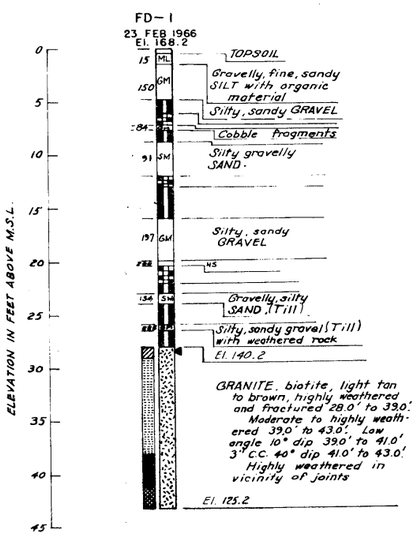
TO ACCOMPANY REPORT DATED: 15, MARCH 1967

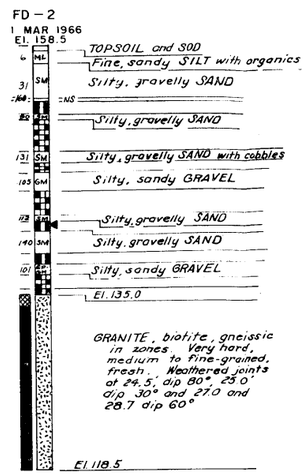
SCALE:
DRAWING NUMBER

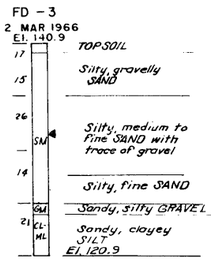
PLATE D-2

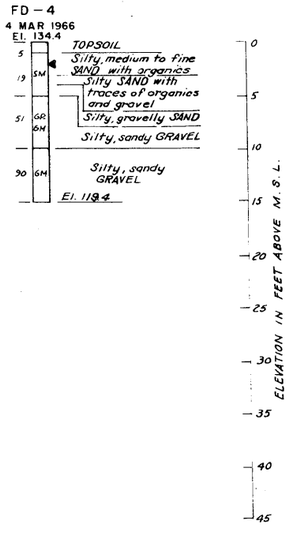
CORPS OF ENGINEERS

U. S. ARMY

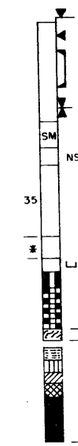




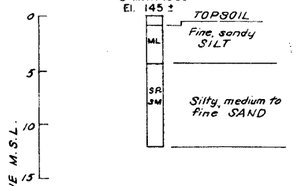


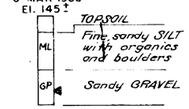


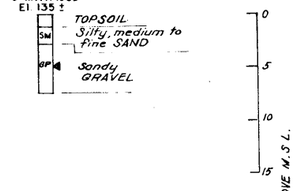
LEGEND FOR GRAPHIC LOGS

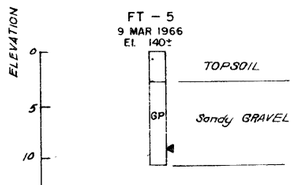


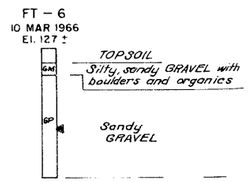
Foundation Test Boring
Date exploration completed
Elevation of ground surface during time of exploration
Maximum artesian head
Subsurface water level in boring at time of exploration
Range of subsurface water during period of observation
Artesian flow encountered
Group letter symbol according to Unified Soil Classification System
Not sampled. Hole advanced by Core-drilling, blasting and/or wash boring due to operational difficulty
Blows per foot of penetration considered most representative for each sample drive using a 350 pound hammer with a free fall of about 18" on a standard 5 foot, solid sample spoon with a beveled, sharpened drive shoe
Blow count not recorded or not considered representative
Bottom of observation well
Cobble or boulder (Core-drilled)
Cobbles or boulders, continuous or nested (Core-drilled and/or blasted and chopped)
El. 120.2 Elevation, bottom of exploration
Rock symbol
Core Recovery (Usually 2⅛" diameter)
0 - 25 %
25 - 50 %
50 - 75 %
75 - 90 %
90 - 100 %
El. 101.5 Elevation bottom of exploration

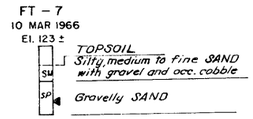


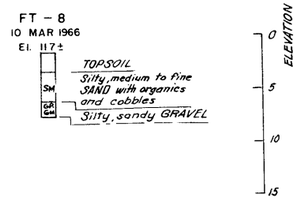












NOTE

Borings FD-1, FD-2, FD-3 and Foundation Test Pit FT-2 made on alternate alignment.
Plan of Foundation Explorations shown on Plates D-1 and D-2.

REVISION	DATE	DESCRIPTION	BY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY	DR. BY	CK. BY
E A B	L H I	R C G

SUBMITTED: CHIEF, GEOLOGY SECTION
APPROVAL RECOMMENDED: CHIEF, F & M BRANCH
REVIEWED: PROJECT ENGINEER
APPROVAL RECOMMENDED: CHIEF, PLANNING BRANCH

NORWALK RIVER FLOOD CONTROL
NORWALK-WILTON LOCAL PROTECTION
RECORD OF FOUNDATION EXPLORATIONS
NORWALK RIVER CONNECTICUT

APPROVED: CHIEF, ENGINEERING DIVISION
DATE: MARCH 1967

TO ACCOMPANY REPORT DATED: 15, MARCH 1967

SCALE

DRAWING NUMBER

PLATE D-3

APPENDIX E

LETTERS OF COMMENT AND CONCURRENCE

APPENDIX E

LETTERS OF COMMENT AND CONCURRENCE

INDEX

Exhibit No.	Agency	Letter Dated
E-1	Soil Conservation Service, USDA	30 Aug. 1966
E-2	Soil Conservation Service, USDA	26 May 1966
E-3	Soil Conservation Service, USDA	7 July 1965
E-4	Fish & Wildlife Service, USDI	15 Apr. 1965
E-5	Conn. Water Resources Comm.	7 July 1965
E-6	Conn. Highway Dept.	25 May 1966
E-7	Norwalk Flood & Erosion Control Board	23 Aug. 1966
E-8	Wilton Flood & Erosion Control Board	16 Aug. 1966

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Old Bookstore Building
Storrs, Connecticut 06268

August 30, 1966

Colonel E. J. Ribbs
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham. Massachusetts 02154

Dear Colonel Ribbs:

We are pleased to advise that the work plan for the Norwalk River Watershed in Fairfield County has been approved by the appropriate Congressional Committees.

Mr. D. A. Williams, Administrator, Soil Conservation Service has authorized us to provide Federal assistance in the installation of the works of improvement on this watershed substantially in accordance with the terms, conditions, and stipulations in the work plan, and the availability of Federal funds appropriated for this purpose.

We plan to begin design operations on this project in the near future. A copy of the work plan is enclosed for your files.

Sincerely yours,

N. Paul Tedrow

N. Paul Tedrow
State Conservationist

Enclosure

EXHIBIT E-1

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Old Bookstore Building
Storrs, Connecticut 06268

May 26, 1966

Colonel Remi O. Renier
Acting Division Engineer
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Colonel Renier:

This will acknowledge your notice of a public hearing to be held on Thursday, May 26, 1966, at Wilton, Connecticut, regarding flood control and allied purposes on the Norwalk River.

We are pleased to learn that preliminary studies by the Corps of Engineers indicate feasibility of local protection between the Grist Mill Road bridge in Norwalk and the proposed Route 7 bridge over the Norwalk River below Wolfpit Road.

The PL-566 watershed protection plan for the Norwalk River, following approval by the towns and the State of Connecticut, was favorably reviewed by the Federal departments concerned. The plan was forwarded to the Bureau of the Budget on December 30, 1965 and it is hoped that the Bureau will send the plan on for Congressional action in the near future. As you know the PL-566 plan recognizes the need for further protection in the downstream areas covered by your studies.

Attached is a copy of the Norwalk River Watershed Work Plan. We suggest it be made a part of the official record of the hearing. Mr. DeElden Philbrook will represent the Soil Conservation Service at the hearing and will be glad to explain any questions that might arise about the PL-566 plan.

We will be glad to cooperate in any way for the continued coordination between the two agencies relative to the Norwalk River.

Sincerely yours,

N. Paul Tedrow
State Conservationist

EXHIBIT E-2

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
Old Bookstore Building
Storrs, Connecticut 06268

July 7, 1965

Mr. John W. Leslie, Chief
Engineering Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Mr. Leslie:

As mentioned in my letter of June 9, 1965, we anticipate that the PL-566 watershed protection work plan for the Norwalk River will be submitted for State and Federal approval in the near future. The towns and the sponsor are anxious that it be submitted for Congressional approval this year.

To facilitate review of the plan, we think it desirable to provide a brief statement about the main points of coordination between our respective agencies relative to the flood control work on the river in Wilton.

We think the salient points are:

1. Based on an understanding between the two agencies reached at a meeting on January 22, 1965, it was agreed that the Corps would plan channel improvements from the new Route 7 bridge downstream to Grist Mill Road bridge and protective measures above the new Route 7 to Wilton Center would be added to the PL-566 plan. Wilton town officials and the local sponsor of the PL-566 plan, (Commissioner J.N. Gill, Dept. of Agriculture & Natural Resources, Hartford,) concurred in this arrangement.

2. Accordingly, channel improvements from Wilton Center to the new Route 7 are included in the PL-566 plan. Protection will be provided against flows based on a recurring 1955 storm (approximately 100-year frequency) as modified by the upstream floodwater storage structures.

EXHIBIT E-3/1

3. Channel improvements downstream from the new Route 7 bridge proposed by the Corps are based on a design flow about 30% greater than the experienced 1955 flood as modified by the PL-566 floodwater retarding structures. It is the viewpoint of the Corps that the higher degree of protection downstream of Route 7 appears appropriate in view of the intensive industrial development in this lower area.

4. Economic evaluations of the PL-566 plan are based on benefits in all reaches including those downstream from the new Route 7 bridge as the first increment to the upstream structures based on protection against the approximately 100-year frequency storm.

5. The Corps' work on the Norwalk River is part of the study of the rivers in the Northeast authorized by resolution of the Senate Public Works Committee adopted September 14, 1955. The following time table is anticipated: Completion of report in calendar year 1965; inclusion in the 1967 Omnibus Bill; Appropriations 1968; Design 1969; and Construction completed in 1972.

We would appreciate any suggestions or additions to the above points that you feel would be helpful in presenting the coordination between our two agencies.

Sincerely yours,

N. Paul Tedrow

N. Paul Tedrow
State Conservationist

cc: Mr. Slagle

EXHIBIT E-3/2

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
59 TEMPLE PLACE
BOSTON, MASSACHUSETTS

April 15, 1965

Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is our conservation and development report on the Norwalk River at Wilton, Fairfield County, Connecticut, local protection project. You are currently studying this program under authority of the Northeast Flood Studies, Resolution of the Senate Committee on Public Works, adopted September 14, 1955. This report has been prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661-666 inc.), in cooperation with the Connecticut State Board of Fisheries and Game. It has the concurrence of that agency as indicated by letter dated April 12, 1965.

It is our understanding that the project is basically one of channel improvement consisting mainly of low earth dikes along the major reach of the improvement and concrete walls along some short reaches. The over-all length of the improvement involves about 10,000 feet extending from where the proposed highway Route 7 crosses the Norwalk River in Wilton downstream to immediately below Grist Mill Road in Norwalk. The bottom channel width would vary from 50-65 feet. As initially planned, a flat-bottomed invert pilot channel three feet deep and eight feet wide would extend the full length of the project.

The Norwalk River is generally polluted throughout the reach of the project. The river is, however, important from a fishery standpoint. Because of the absence of any other suitable stream and the great demand for a trout fishery in this area, the State maintains a trout fishery in this segment of the Norwalk River through stocking. Warm summer temperatures eliminate this fishery by midsummer.

EXHIBIT E-4/1

There are no wildlife values associated with this project.

Mr. Nelson of our Concord Area Office discussed this project with Mr. Slagle of your staff on March 4, 1965, with a view towards seeking reasonable modifications in your plan in the interest of the fishery resource. In lieu of the eight-foot wide flat bottom pilot channel, it was agreed that project plans would be modified to include a V-shaped channel three feet deep, with a top width of 15 feet and one on 2-1/2 side slopes. This V-shaped channel would extend from the upper limit of the project down through the ledge immediately upstream of Grist Mill Road Bridge. This channel modification would prevent any fishery losses throughout the length of the improvement by concentrating the normal stream flows.

In view of the agreement reached on the desired project modification, we have no further recommendations to make nor do we anticipate reporting further on this project. We appreciate the excellent cooperation shown by your staff in the preparation of this report.

Sincerely yours,

Travis S. Roberts

Travis S. Roberts
Acting Regional Director

EXHIBIT E-4/2

STATE OF CONNECTICUT

BOARD OF FISHERIES AND GAME

STATE OFFICE BUILDING • HARTFORD 15, CONNECTICUT

R
2
3
1 ED

April 12, 1965

Mr. Richard Griffith, Regional Director
U.S. Dept. of the Interior
Fish and Wildlife Service
Blake Building
59 Temple Place
Boston, Mass.

Attention: Mr. Ralph A. Schmidt

Dear Mr. Griffith:

Thank you for your conservation and development report on the Norwalk River in Wilton. We are in concurrence with your report.

Sincerely yours,

Theodore B. Bampton

Theodore B. Bampton
Director

TBB:dg

RECEIVED
APR 1 [illegible] 1965
R. B. S.

EXHIBIT E-4/3

STATE OF CONNECTICUT
WATER RESOURCES COMMISSION
STATE OFFICE BUILDING · HARTFORD 15, CONNECTICUT

July 7, 1965

Mr. John Wm. Leslie, Chief
U. S. Army Engineer Division
New England Division
424 Trapelo Road
Waltham, Massachusetts

Dear Mr. Leslie:

Reference is made to your letter of June 2, 1965 concerning the proposed flood control project along the Norwalk River from Grist Mill Road in Norwalk upstream to the proposed Route 7 bridge in Wilton.

This Commission in 1958 developed plans for a similar project extending upstream to Kent Road and in 1962 prepared plans for channel improvements at selected locations upstream to Wilton Center. Your proposed project and our plans provide similar protection except that your plans provide continuous protection through the reach extending upstream to the proposed Route 7 crossing. In this reach continuous protection is desirable in view of recent and probable future developments along the river.

The Norwalk Flood and Erosion Control Board has consistently promoted the project and we understand that Wilton will, in the near future, hold a referendum to determine its course of action.

We feel that your proposed project together with upstream storage facilities to be provided by the Soil Conservation Service in cooperation with the Commissioner of Agriculture is the most suitable means of providing the flood protection needed to insure against future flood damages.

Very truly yours,

William S. Wise

William S. Wise
Director

WSW:js

EXHIBIT E-5

STATE OF CONNECTICUT
STATE HIGHWAY DEPARTMENT
24 WOLCOTT HILL ROAD, WETHERSFIELD
P.O. BOX 2188, HARTFORD 15, CONNECTICUT

In Reply Refer to Unit 1004
May 25, 1966

Colonel Remi O. Renier
Acting Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Dear Colonel Renier:

Subject: Flood Control, Norwalk River, Norwalk and Wilton, Connecticut

This will acknowledge your Notice of a Public Hearing to be held on Thursday, May 26, 1966 at Wilton, Connecticut regarding flood control and allied purposes on the Norwalk River in the towns of Norwalk and Wilton.

Your notice states that preliminary studies by the Corps indicate that local protection in this area is necessary and appears to be economically justified. The study plans which you have outlined in your Notice of Public Hearing will require close coordination between the U. S. Soil Conservation Service, the U. S. Army Engineers and the Connecticut Highway Department, especially in the vicinity of the proposed crossing of the Norwalk River by relocated Route U. S. 7 just south of Route 33 interchange.

You may be assured that the Highway Department will continue to cooperate in the development of plans for the relocation of Route U. S. 7 as they may be affected by the local protection project now being considered by your office.

Very truly yours,

Howard S. Ives
State Highway Commissioner

RAN:jw

EXHIBIT E-6

CITY OF NORWALK

OFFICE OF THE FLOOD AND EROSION CONTROL BOARD

NORWALK, CONNECTICUT

August 23, 1966

U.S. Army Engineer Division,
New England
Corps of Engineers
424 Trapelo Road
Waltham, Mass. 02154

Gentlemen:

The Flood and Erosion Control Board of the City of Norwalk at its meeting August 22, 1966, concurred in the belief that there is a necessity for a flood control project in the Grist Mill Area of the Norwalk River to the Wilton town line.

The plan outlined on the map prepared by the U.S. Army Engineer Division, New England, Corps of Engineers appears to meet the need.

Sincerely,

LeRoy D. Downs
Chairman

LDD/fk

EXHIBIT E-7

TOWN OF WILTON

FLOOD AND EROSION CONTROL BOARD

WILTON, CONNECTICUT

August 16, 1966

Colonel Remi O. Renier,
U.S. Army Engineer Division,
424 Trapelo Road,
Waltham, Mass.

Dear Colonel Renier,

Further to our recent correspondence and the writer's phone conversation with your Project Engineer, Mr. William Slagle, last Thursday, this letter confirms that our Board officially approves the Corps of Engineers' flood control project Plan 'A', for the Norwalk River in Wilton, south from the Wolfpit Road area to the Norwalk line. (The project plan includes the area south from the Wilton-Norwalk town line to Grist Mill Road).

It is our hope that the Corps will be able to present the completed plan at an early date since protection from floods is long overdue for our fast-growing, defense-oriented research and manufacturing and commercial areas. We believe the Corps' Plan 'A' can meet every requirement.

In passing, we should like to add that our Board remains much impressed by the efficiency, the helpfulness, and the patience of all Corps of Engineers personnel with whom we have been in contact.

Sincerely,

Peter W. R. Johnson, Chairman,
Wilton Flood & Erosion Control Board.

PWRJ/fwj

EXHIBIT E-8

APPENDIX F

INFORMATION CALLED FOR BY

SENATE RESOLUTION 148, 85th CONGRESS

ADOPTED 28 JANUARY 1958

NORWALK RIVER BASIN

Information Called For By
Senate Resolution 148, 85th Congress
Adopted 28 January 1958

1. PROJECT DESCRIPTION AND ECONOMIC LIFE

a. General. The city of Norwalk and town of Wilton, Connecticut have suffered serious damages from past floods on the Norwalk River and can best be protected from future floods by local protection works. The recommended project is described briefly in succeeding paragraphs and more fully in the main report and in Appendix D and shown on plates in the main report and in Appendix D.

b. Norwalk-Wilton local protection. The recommended project, extending about 10,000 feet along Norwalk River in Norwalk and Wilton, consists of improvement of the river channel, protection of the banks by dikes and walls, and construction of an interior drainage system. The alignment would generally follow the present course of the Norwalk River from a point 550 feet downstream of Grist Mill Road bridge in Norwalk upstream to the proposed Route 7 river crossing in Wilton. The channel would have a bottom width of 60 feet for the lower 950 feet of its course and 65 feet for the remainder of the project. A V-shaped pilot channel, 3 feet in depth, would be provided along most of the length of the channel improvement in order to concentrate flows for fish. Dikes, supplemented by metal bin-type retaining walls and one short stretch of concrete wall, would protect low areas of river bank.

An area comprising two small ponds formed in gravel pits at the upstream end of the project and now used for seasonal swimming would be essentially unaltered by the project. Although one of the ponds lies in the project area, both could be used as at present or could be developed for more intensive recreational use at any time without conflicting with the recommended project alignment.

The assumed project life for economic evaluation for all studied project plans is 100 years.

c. Alternative alignments. Two alignments alternative to the recommended plan were considered but not recommended because of opposition to them by local interests. These plans differ from the recommended plan only in the portion of the project upstream of Kent

Road bridge, where both rejected alignments would extend along the railroad embankment instead of following the general course of the river as in the recommended plan. In one considered alternative, the east bank dike would veer away from the main channel at the upstream end of the project in the vicinity of Arrowhead Road to enclose the pond area and allow for recreational development. Recreation could be considered a project purpose in this plan. In the other considered alternative plan, the east bank dike would follow alongside the channel and would fill in the ponds with consequent elimination of the recreational use.

d. Channel design flows. Five design flows ranging from 6,400 c.f.s. to 14,300 c.f.s. were studied for the recommended and alternative alignments. The smallest of the flows, representing the maximum flood of record, modified by upstream structures proposed in the approved Soil Conservation Service plan, would provide the minimum protection. The largest, a flow approximately one-third greater than the standard project flood modified by the SCS plan, would provide an extremely high degree of protection. A flow of 10,800 c.f.s., recommended for project design, affords standard project flood protection to a large urban area of Norwalk and Wilton.

2. PROJECT COSTS

Project first costs are based on average bid prices for similar work in the same general area adjusted to 1966 price levels. Valuation of property is based on the Market Data approach and reflects recent sale values in the area. Land costs are based on the estimated fee value. All estimates include allowances for contingencies and costs for engineering and overhead. The interest rate is 3-1/8 percent for Federal and non-Federal costs.

Table 3 in the main report presents a summary of first costs and annual charges for the recommended project with details given in Appendix D. Table F-1 at the end of this supplement, shows a comparison of annual charges for the recommended project based on 50- and 100-year economic lives.

3. PROJECT BENEFITS AND BENEFIT-COST RATIO

The maximum excess of benefits over costs would be realized by a project designed to protect against a flow of 6,400 c.f.s., the minimum protection considered. However, to obtain reasonable protection for this highly-urbanized area, the recommended project is

designed for a flow of 10,800 c.f.s., the standard project flood modified by the Soil Conservation Service plan upstream. This degree of protection still gives a substantial excess of benefits over costs. Table 2 in the main report shows the costs, benefits and excess of benefits over costs for the various considered design flows.

4. INTANGIBLE PROJECT BENEFITS

Elimination of the menace to life posed by raging flood waters and of the danger of disease, ever present in the aftermath of a serious flood, would improve the social and economic climate of the now flood-prone areas of Norwalk and Wilton.

5. PHYSICAL FEASIBILITY AND COST OF PROVIDING FOR FUTURE NEEDS.

The entire flood plain in Norwalk and Wilton at present rates of growth will be completely built over by 1970. In planning for flood protection of this area, future flood control needs are considered.

The recommended project will in no way limit present recreational usage or preclude future development for recreation at the ponds at the upper end of the project area. Project planning therefore takes into consideration future water resource needs of the area insofar as the project affects those needs.

6. ALLOCATION OF COSTS

The project is for flood control only and therefore no allocation of project costs among purposes is required.

7. REPAYMENT SCHEDULES

There are no reimbursable functions incorporated in the recommended project.

8. EFFECT OF PROJECT ON STATE AND LOCAL GOVERNMENTS

The project will have little adverse effect on present State and local governmental services since the areas to be protected are already largely served by existing utilities and sewers, have police and fire protection, schools and other public services.

The loss of taxes on land required for project purposes will undoubtedly be more than offset by higher valuations on property afforded protection.

9. PROPOSED INCREASES IN APPROPRIATIONS

The construction would require a Federal appropriation of $2,700,000. This is the only recommendation by the Corps of Engineers contemplated for the basin at this time and, together with the authorized plan of the Soil Conservation Service, constitutes a comprehensive plan for development of the basin resources.

TABLE F-1
COST ANALYSIS - 50-YEAR AND 100-YEAR LIFE
(1966 Price Level)

Item		50-Year Life		100-Year Life
First Cost				
Federal	$	2,700,000	$	2,700,000
Non-Federal		1,600,000		1,600,000
TOTAL FIRST COST	$	4,300,000	$	4,300,000
Annual Charges				
Federal				
Interest	$	84,400	$	84,400
Amortization		23,100		4,100
Total Federal	$	107,500	$	88,500
Non-Federal				
Interest	$	50,000	$	50,000
Amortization		13,700		2,500
Maintenance		4,000		4,000
Total Non-Federal	$	67,700	$	56,500
TOTAL ANNUAL CHARGES	$	175,200	$	145,000
Annual Benefits	$	193,200	$	193,200
Benefit-Cost Ratio		1.1		1.3